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AFATL-TR-75-87, VOLUME II

EXTERNAL STORE AIRLOADS PREDICTION TECHNIQUE

VOLUME II. DETAILED DATA

BOOK 2. SINGLE CARRIAGE AIRLOADS PREDICTIONS

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EGLIN AIR FORCE BASE, FLORIDA

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SECTION III

SINGLE CARRIAGE AIRLOAD PREDICTION

The technique for predicting single carriage six-component captive airloads is presented in this section. Each of the six airload components are presented in separate subsections. Each airload component subsection is ordered into additional subsections for predicting the basic captive airload, the incremental airload due to aircraft yaw, and the incremental airload due to adjacent store interference. The basic captive airload prediction method is generated from wind tunnel data obtained by a zero-yaw pitch excursion of the parent aircraft. The aircraft yaw airloads data are generated by a pitch excursion of the parent aircraft at selected constant yaw angles. The incremental airloads due to aircraft yaw are obtained from the difference between the yawed pitch polar and the zero-yaw pitch polar (basic captive airload). The incremental airloads due to adjacent store interference were obtained as the difference between the airloads experienced by the captive store with and without the presence of an adjacent store through a zero-yaw pitch excursion of the parent aircraft.

An analysis of the experimental data indicated that the store captive airloads could be adequately described by a linear curve over a large range of angle of attack. The technique presented in this section predicts the slope and intercept at M=0.5 for each of the store airload components. The effects of Mach number, aircraft yaw, and adjacent store interference are treated as increments to be added to the slope and intercept predicted at M=0.5. Each airload component is computed in terms of force or moment per unit q (dynamic pressure), and coefficients are defined by dividing the force terms by the store reference area, S_{REF}, and the moment terms by the product of the store reference area and diameter, $S_{REF}d$.

To obtain the total airload experienced by a captive store, use the generalized coefficient equation presented below.

$$C_{x_{TOTAL}} = C_{x_{BASIC}} + \Delta C_{x_{\beta_S}} \cdot \beta_S + \Delta C_{x_{INTF}}$$

where:

$x = y, \eta, N, M, A, \ell$

3.1 SIDE FORCE

3.1.1 Basic Airload

3.1.1.1 Slope Prediction

The equation for predicting the variation of side force with angle of attack for Mach number 0.5 is presented below.

$$\left(\frac{SF}{q}\right)_{\alpha_{PRED}} = K_{C_{SF}} \left(\frac{SF}{q}\right)_{\psi_{ISO}} K_{\eta} K_{INTF} K_{L/C} K_Z K_{\Lambda_1}$$

where:

$K_{C_{SF}} \left(\frac{SF}{q}\right)_{\psi_{ISO}}$ - Initial side force slope prediction, see Subsection 2.3.2.

K_{η} - Store spanwise position correction factor, Figure 13.

K_{INTF} - Correction factor accounting for the interference effect of the fuselage for high wing aircraft, Figure 14.

$K_{L/C}$ - Correction factor based on store length divided by the local wing chord, Figure 15.

K_Z - Correction factor accounting for pylon height variation, Figure 16.

K_{Λ_1} - Aircraft wing sweep correction factor, $\sin\Lambda/\sin 45^{\circ}$, where Λ is quarter chord sweep of subject wing.

Example:

Compute $\left(\frac{SF}{q}\right)_\alpha$ for a 300-gallon tank on the A-7 center wing pylon at M=0.5.

Required for Computation:

$$\eta = .418$$

$$\frac{Y}{d} = 2.57$$

$$\frac{L}{C_{LOCAL}} = 1.77$$

$$Z = 23 \text{ in.}$$

$$K_{\Lambda_1} = \frac{\sin 35^\circ}{\sin 45^\circ} = .811$$

$$K_C \left(\frac{SF}{q}\right)_{\psi_{ISO}} = (1.206)(.262) = .316 \frac{ft^2}{deg}$$

$K_\eta = .96$ - Figure 13

$K_{INTF} = 1.0$ - Figure 14

$K_{L/c} = 1.27$ - Figure 15

$K_Z = .98$ - Figure 16

$$\left(\frac{SF}{q}\right)_{\alpha_{PRED}} = (.316)(.96)(1.0)(1.27)(.98)(.811) = .306 \frac{ft^2}{deg}$$

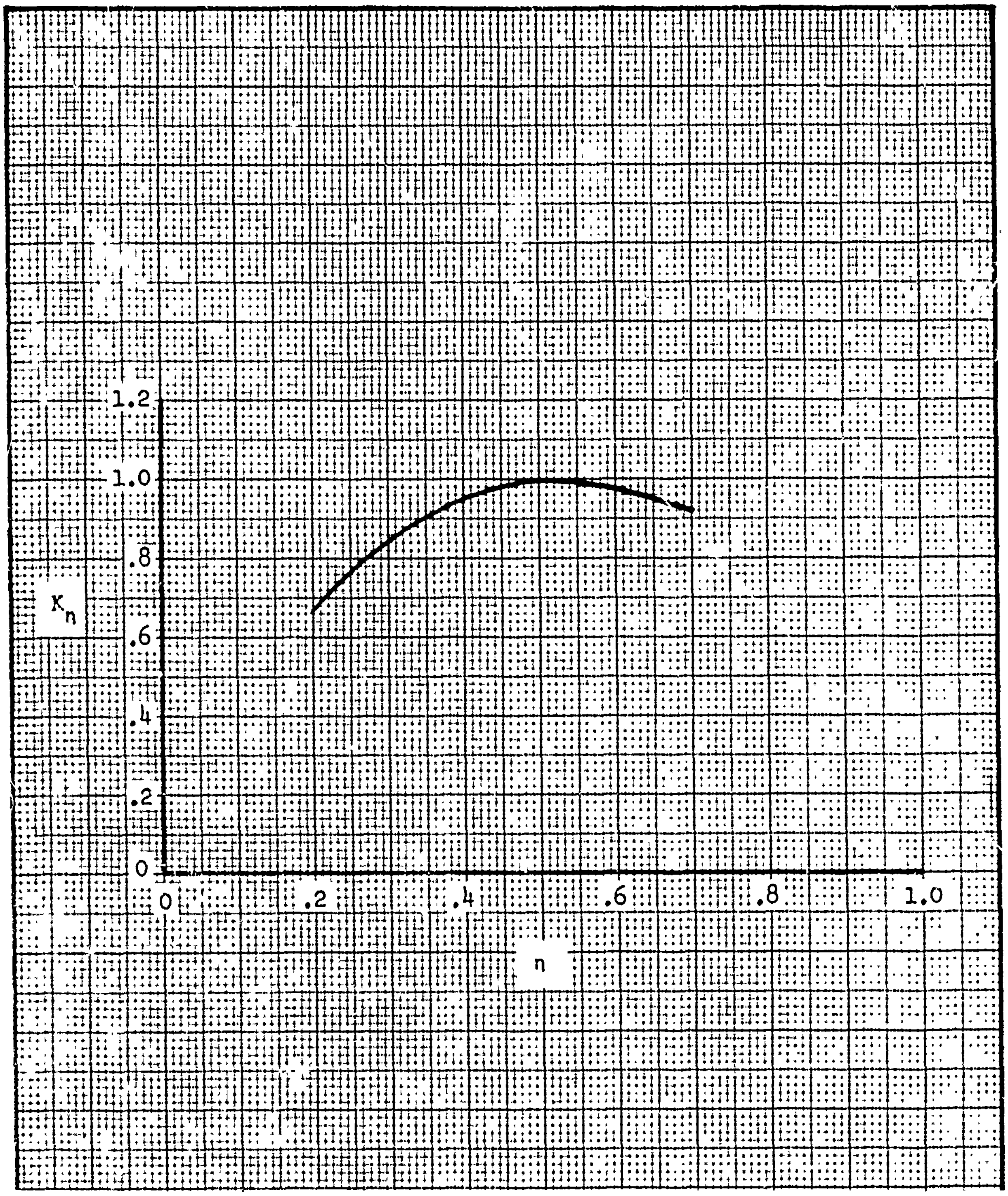

Figure 13. Side Force Slope - Spanwise Correction

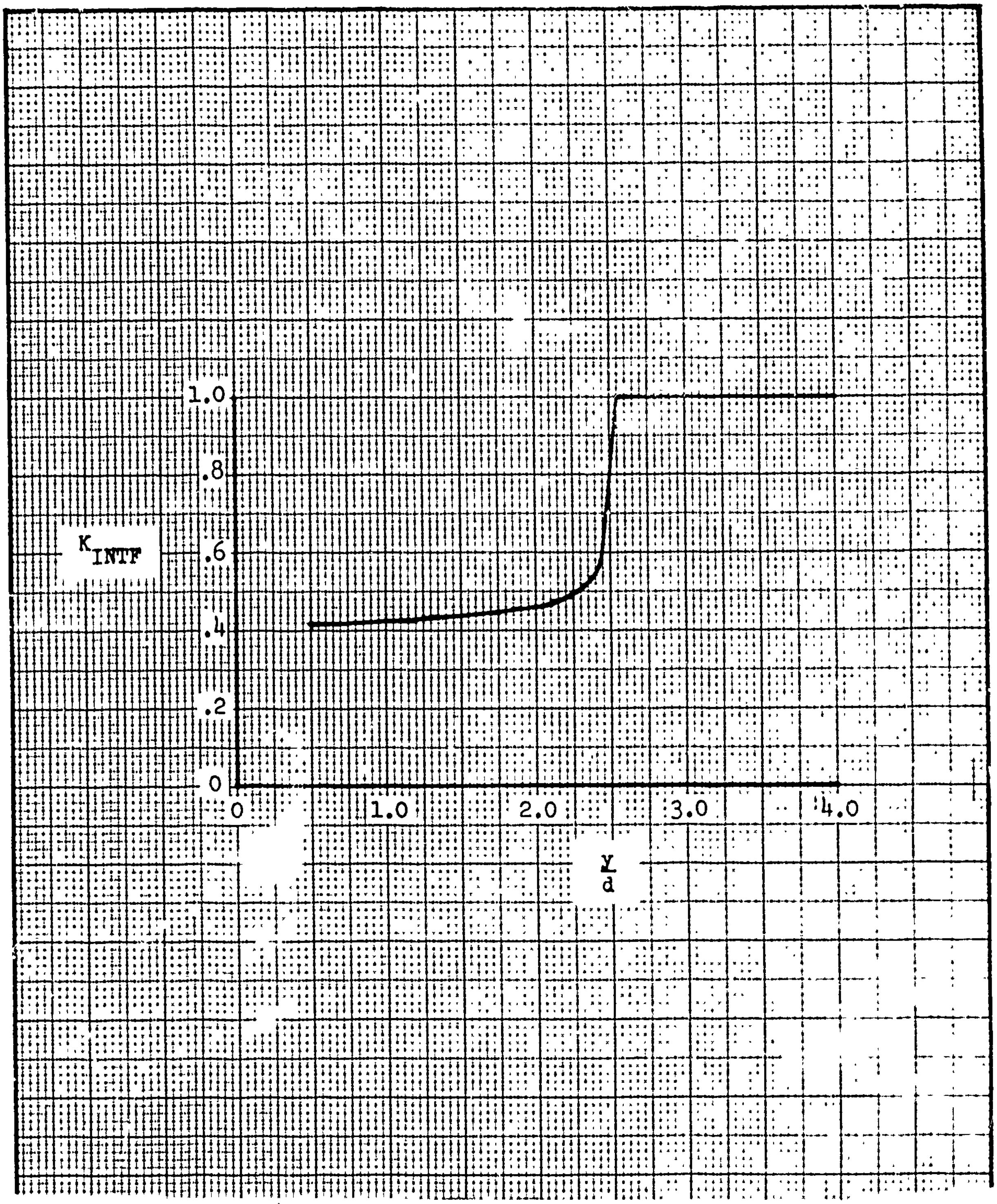

Figure 14. Side Force Slope - Fuselage Interference Correction

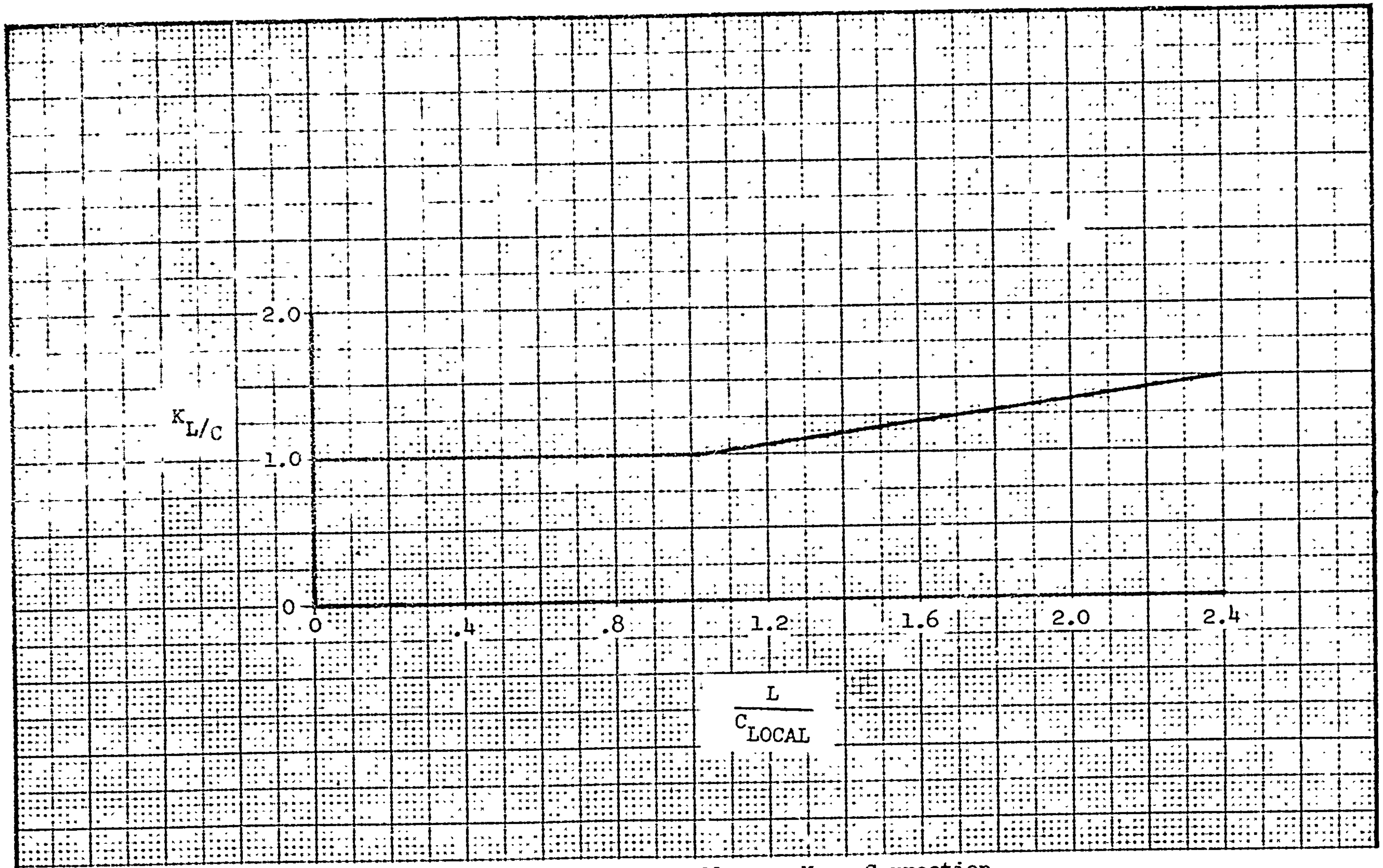

Figure 15. Side Force Slope - $K_{L/C}$ Correction

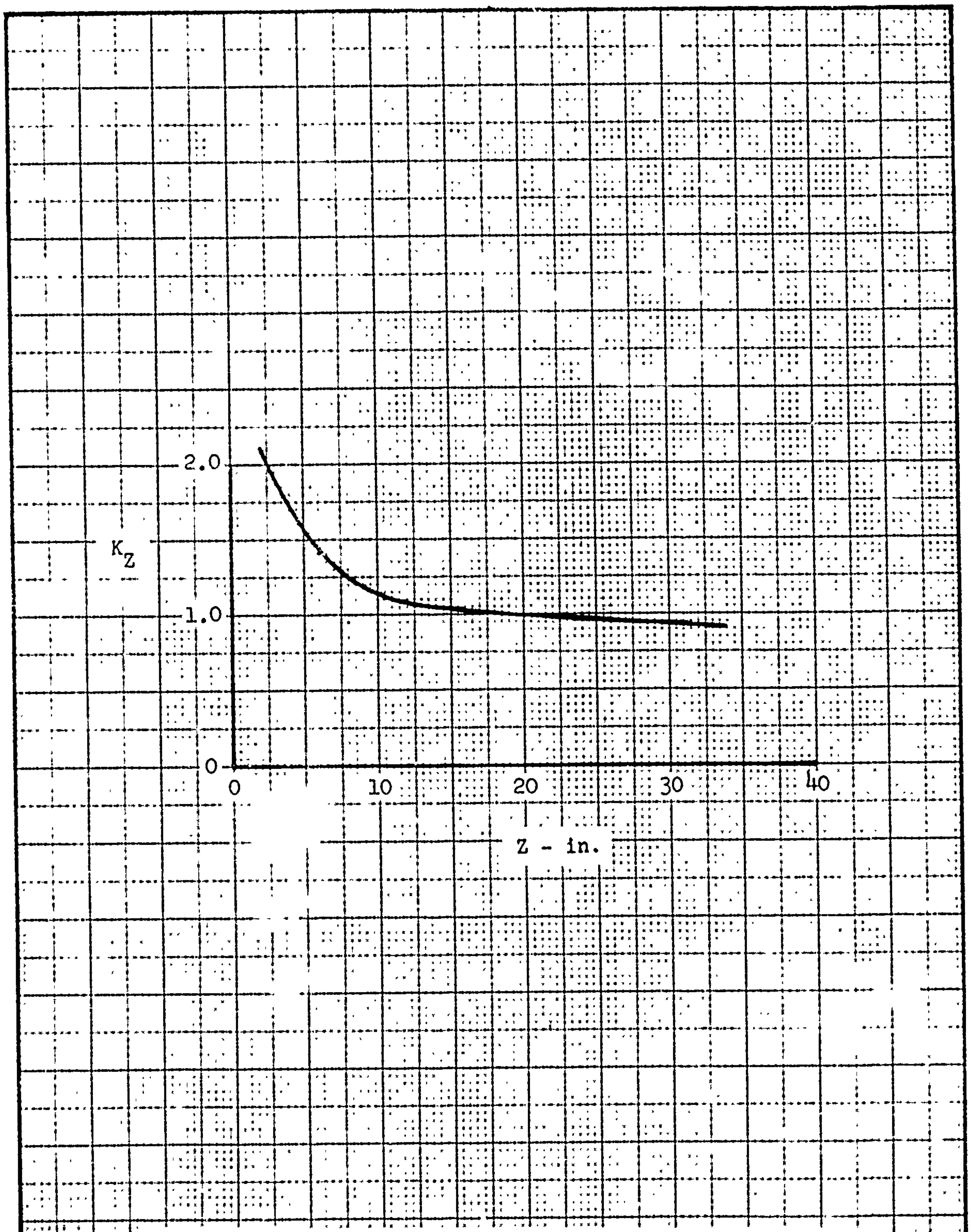

Figure 16. Side Force Slope - Pylon Height Correction

3.1.1.2 Slope Mach Number Correction

To compute the variation in side force slope, $\left(\frac{SF}{q}\right)_\alpha$, between $M = 0.5$ and $M = 2.0$, use the following expression:

$$\left(\frac{SF}{q}\right)_{\alpha_{M = x}} = \left(\frac{SF}{q}\right)_{\alpha_{PRED}} + \Delta\left(\frac{SF}{q}\right)_{\alpha_{M = x}}$$

where:

$\left(\frac{SF}{q}\right)_{\alpha_{PRED}}$ - Side force slope predicted at $M = 0.5$.

$\Delta\left(\frac{SF}{q}\right)_{\alpha_{M = x}}$ - Increment in side force slope at $M = x$.

A generalized curve depicting the side force slope variation with Mach number is given by Figure 17.

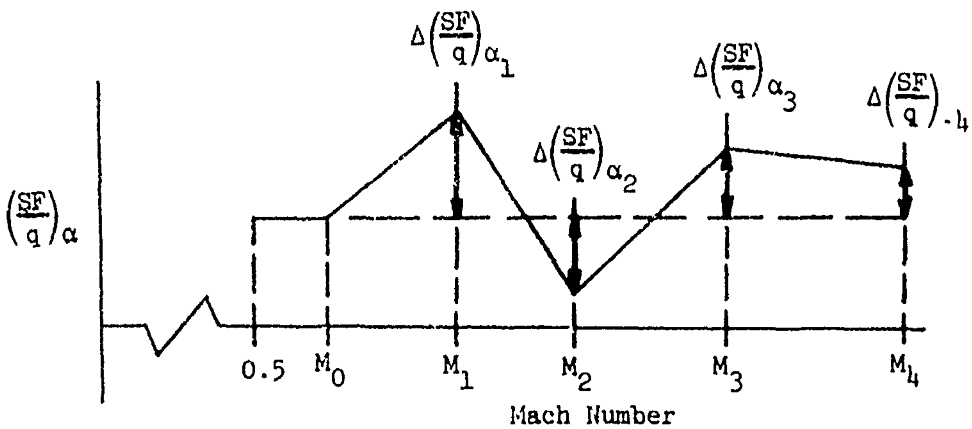

Figure 17. Side Force Slope - Generalized Mach Number Variation

The slope variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, M_3, and M_4. The variation of the Mach break points is presented in Figure 18 as a function of C_{LOCAL} K_{Λ_1}. M_0 is the Mach number where the slope initially deviates from the slope predicted at $M = 0.5$. Equations have been developed to predict

the delta (incremental) slope change from that predicted at $M = 0.5$ at each of the remaining Mach break points (M_1, M_2, etc.). These equations are presented below.

Break 1 (M_1):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_1} = [K_{SLOPE_1}(\text{ADJ. FIN SPA}) + K_{INTC_1}]S_{REF}$$

where:

K_{SLOPE_1} - Variation of $\Delta C_{y_{\alpha_1}}$ with ADJ. FIN SPA, $\frac{1}{in^2 deg}$, Figure 19.

ADJ. FIN SPA - Adjusted fin side projected area, in^2, defined in Subsection 2.3.1.

K_{INTC_1} - Value of $\Delta C_{y_{\alpha_1}}$ when ADJ. FIN SPA = 0, $\frac{1}{deg}$, Figure 20.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

Break 2 (M_2):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_2} = [K_{SLOPE_{\eta_2}} K_{SLOPE_2}(\text{ADJ. NOSE SPA}) + K_{INTC_{\eta_2}} K_{INTC_2}]S_{REF}$$

where:

$K_{SLOPE_{\eta_2}}$ - Slope correction factor based on spanwise position, Figure 21.

K_{SLOPE_2} - Variation of $\Delta C_{y_{\alpha_2}}$ with ADJ. NOSE SPA, $\frac{1}{in^2 deg}$, Figure 22.

ADJ. NOSE SPA - Adjusted nose side projected area, in^2, defined in Subsection 2.3.1.

$K_{INTC_{\eta_2}}$ - Intercept correction factor based on spanwise position, Figure 23.

K_{INTC_2} - Value of $\Delta C_{y_{\alpha_2}}$ when ADJ. NOSE SPA = 0, $\frac{1}{deg}$, Figure 24.

Break 3 (M_3):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_3} = [K_{SLOPE_{\eta_3}} K_{SLOPE_3} (\text{ADJ. FIN SPA}) + K_{INTC_{\eta_3}} K_{INTC_3}] S_{REF}$$

where:

$K_{SLOPE_{\eta_3}}$ - Slope correction factor based on spanwise position, Figure 25.

K_{SLOPE_3} - Variation of $\Delta C_{y_{\alpha_3}}$ with ADJ. FIN SPA, $\frac{1}{in^2 deg}$, Figure 26.

ADJ. FIN SPA - Defined under Break 1.

$K_{INTC_{\eta_3}}$ - Intercept correction factor based on spanwise position, Figure 27.

K_{INTC_3} - Value of $\Delta C_{y_{\alpha_3}}$ when ADJ. FIN SPA = 0, $\frac{1}{deg}$, Figure 28.

Break 4 (M_4):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_4} = [K_{SLOPE_4} (\text{ADJ. FIN SPA}) + K_{INTC_4}] S_{REF}$$

where:

K_{SLOPE_4} - Variation of $\Delta C_{y_{\alpha_4}}$ with ADJ. FIN SPA, $\frac{1}{in^2 deg}$, Figure 29.

ADJ. FIN SPA - Defined under Break 1.

K_{INTC_4} - Value of $\Delta C_{y_{\alpha_4}}$ when ADJ. FIN SPA = 0, $\frac{1}{deg}$, Figure 30.

To compute $\left(\frac{SF}{q}\right)_\alpha$ at M = x, first determine from Figure 18 between which Mach number break points M x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\left(\frac{SF}{q}\right)_\alpha$ at M = x from the expression below.

$$\left(\frac{SF}{q}\right)_{\alpha_{M=x}} = \left(\frac{SF}{q}\right)_{\alpha_{PRED}} + \Delta\left(\frac{SF}{q}\right)_{\alpha_{LOW}} + \left(\frac{x - M_{LOW}}{M_{HI}-M_{LOW}}\right) [\Delta\left(\frac{SF}{q}\right)_{\alpha_{HI}} - \Delta\left(\frac{SF}{q}\right)_{\alpha_{LOW}}]$$

If $x \leq M_0$, $\left(\frac{SF}{q}\right)_{\alpha_{M=x}}$ will be the value obtained in Subsection 3.1.1.1 (the initial term in the above equation).

Example:

Compute the side force variation with angle of attack for a 300-gallon tank on the center pylon for M = 1.4.

C_{LOCAL} = 127.6 in.

$K_{\Lambda_1} = \frac{\sin 35°}{\sin 45°} = .811$

η = .418

ADJ. NOSE SPA = 3111 in^2 (Subsection 2.3.1)

ADJ. FIN SPA = 990 in^2 (Subsection 2.3.1)

S_{REF} = 3.83 ft^2

$C_{LOCAL}K_{\Lambda_1}$ = (127.6)(.811) = 103.5 in.

From Figure 18, M = 1.4 falls between M_2 and M_3. Let M_{LOW} = M_2 = 1.2, and M_{HI} = M_3 = 1.6.

Break 2 (M_2):

$K_{SLOPE_{\eta_2}} = .64$ - Figure 21

$K_{SLOPE_2} = -.000005$ - Figure 22

$K_{INTC_{\eta_2}} = .56$ - Figure 23

$K_{INTC_2} = .015$ - Figure 24

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_2} = [(.64)(-.000005)(3111) + (.56)(.015)]3.83 = -.0060\ \frac{ft^2}{deg}$$

Break 3(M_3):

$K_{SLOPE_{\eta_3}} = .58$ - Figure 25

$K_{SLOPE_3} = -.000066$ - Figure 26

$K_{INTC_{\eta_3}} = .22$ - Figure 27

$K_{INTC_3} = .055$ - Figure 28

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_3} = [(.58)(-.000066)(990) + (.22)(.055)]3.83 = -.098\ \frac{ft^2}{deg}$$

$$\left(\frac{SF}{q}\right)_{\alpha_{PRED}} = .306\ \frac{ft^2}{deg}$$

then:

$$\left(\frac{SF}{q}\right)_{\alpha_{M = 1.4}} = .306 - .0060 + \left(\frac{1.4 - 1.2}{1.6 - 1.2}\right)[-.098 - (-.0060)]$$

$$= .254 \ \frac{ft^2}{deg}$$

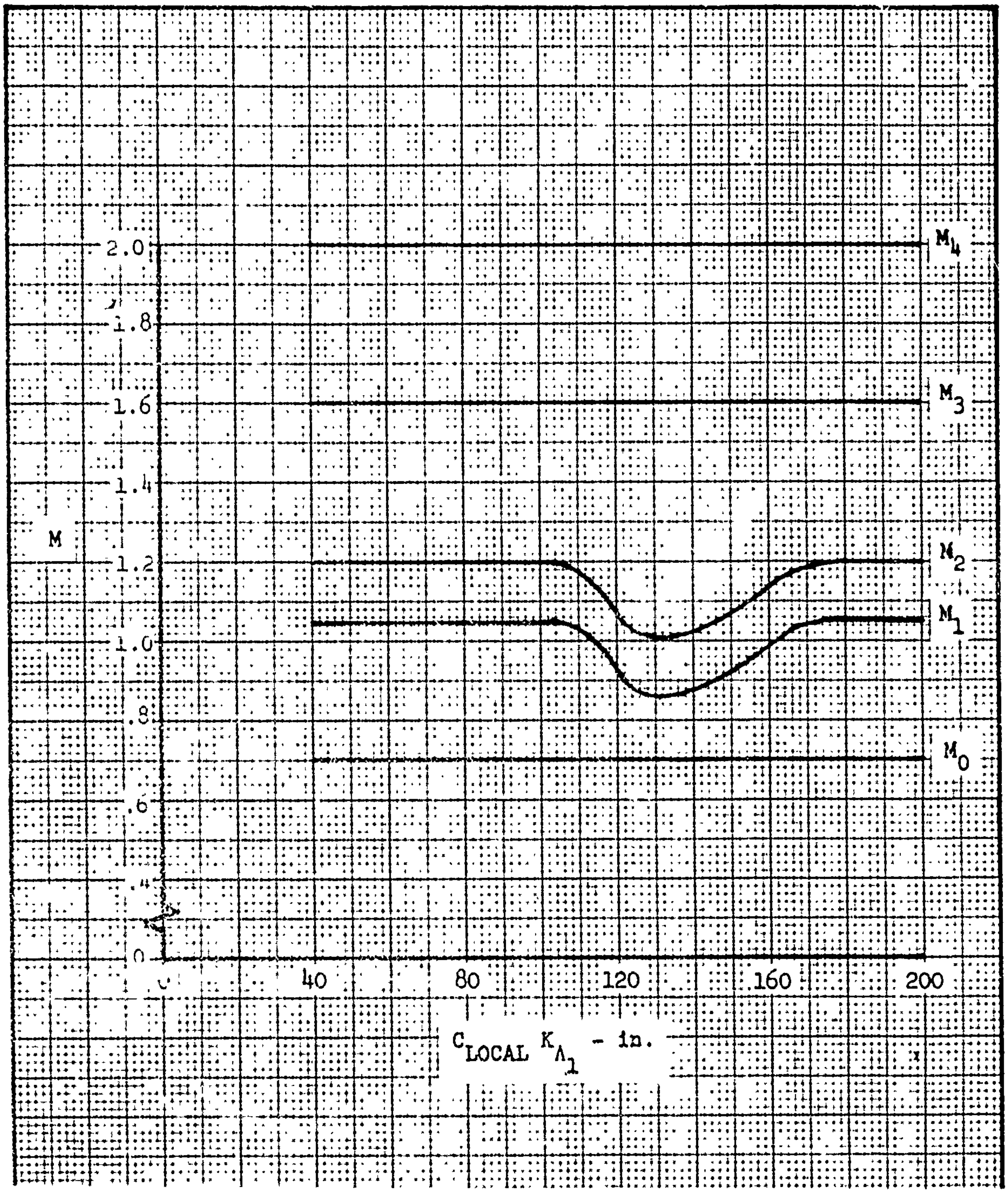

Figure 1?. Side Force Slope - Mach Number Break Points

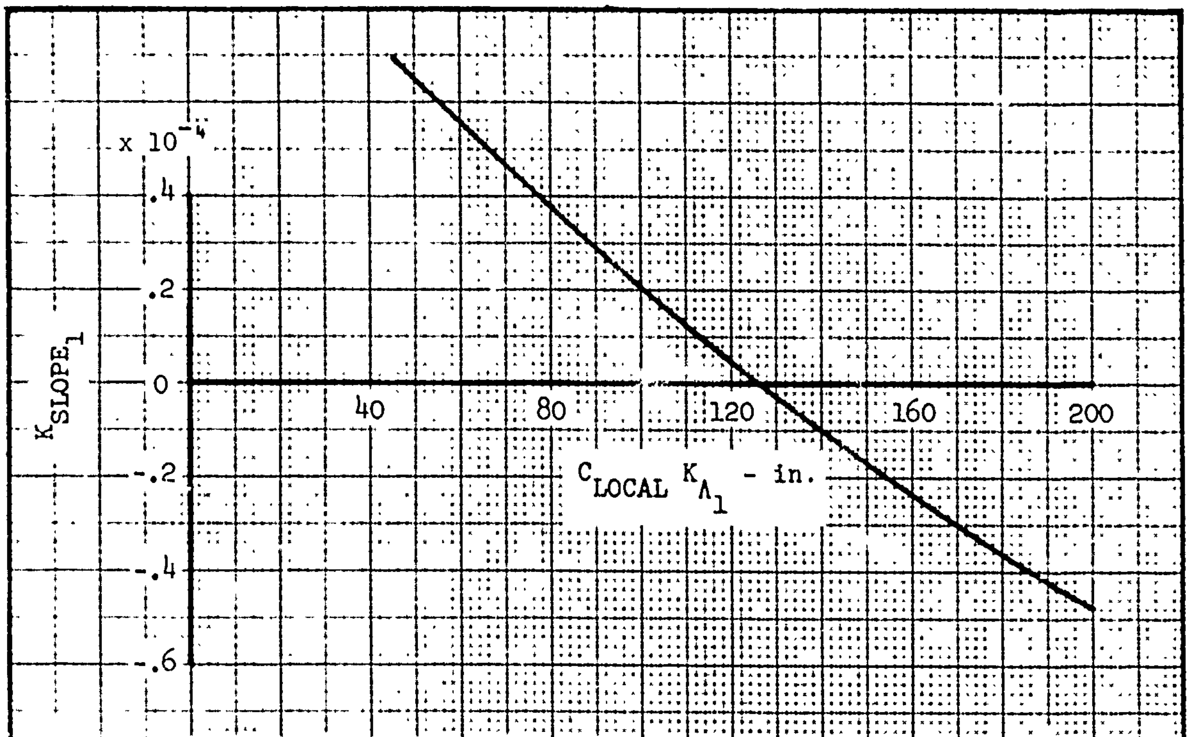

Figure 19. Side Force Slope - K_{SLOPE} for Mach Break 1

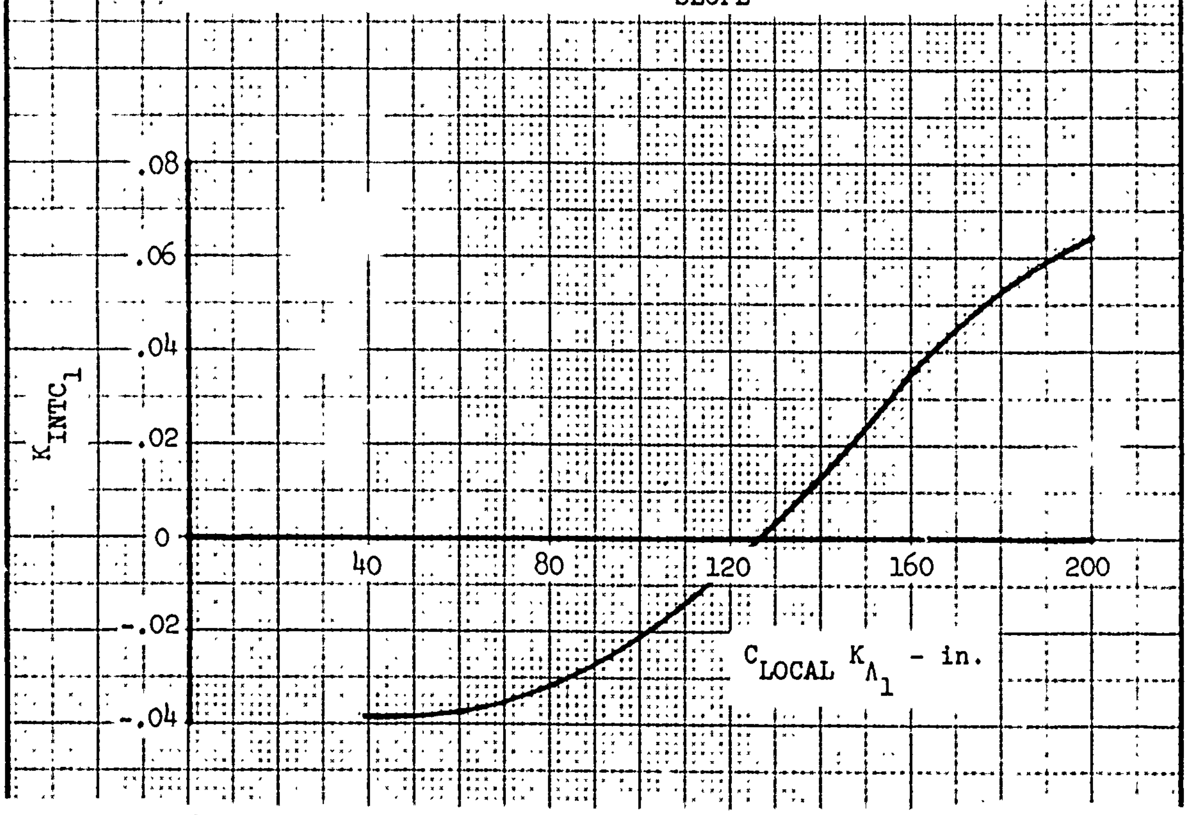

Figure 20. Side Force Slope - K_{INTC} for Mach Break 1

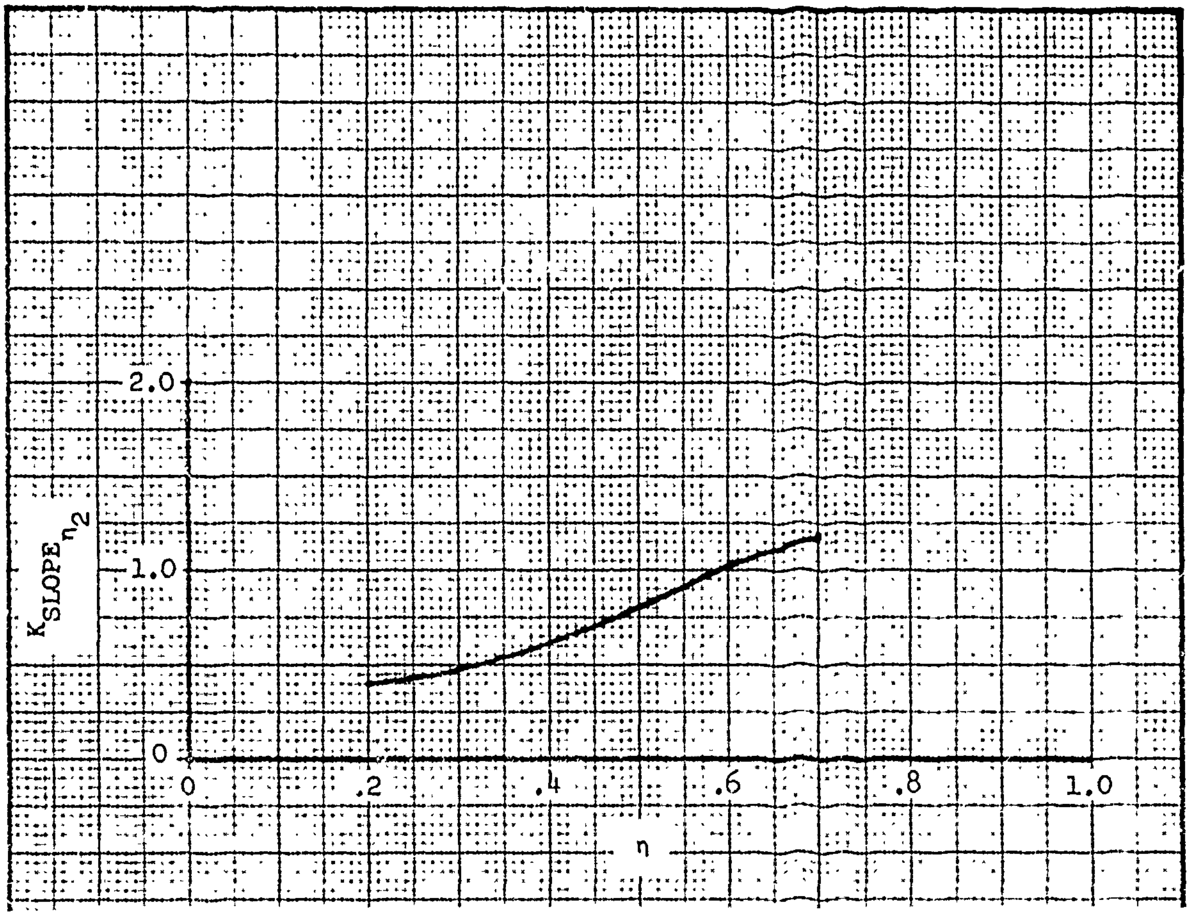

Figure 21. Side Force Slope - K_{SLOPE_2} Spanwise Correction

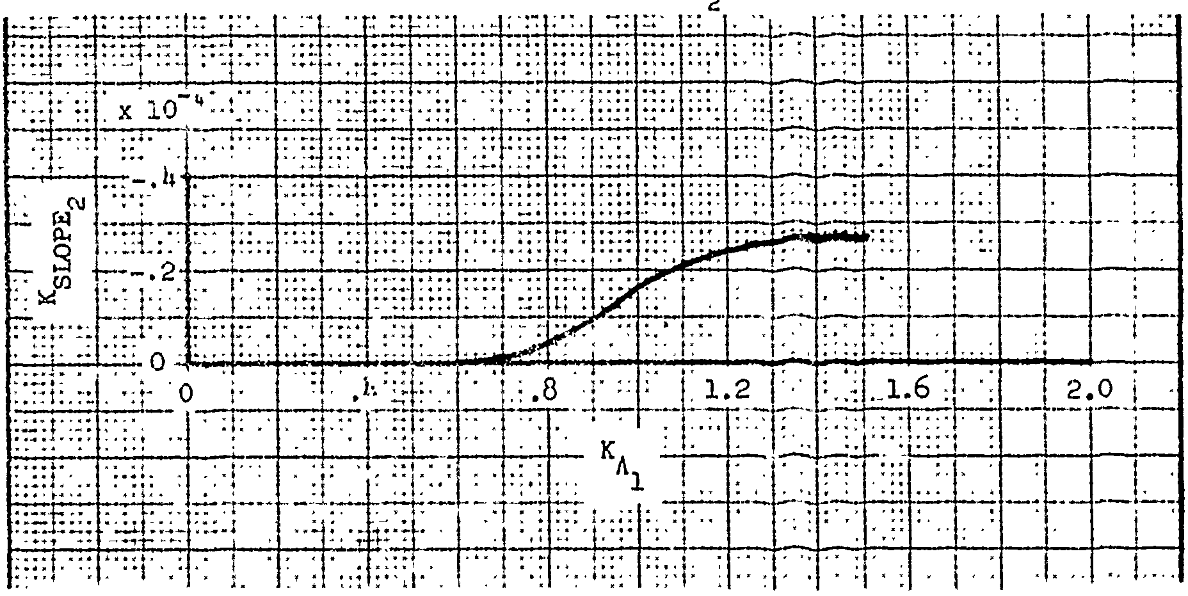

Figure 22. Side Force Slope - K_{SLOPE} for Mach Break 2

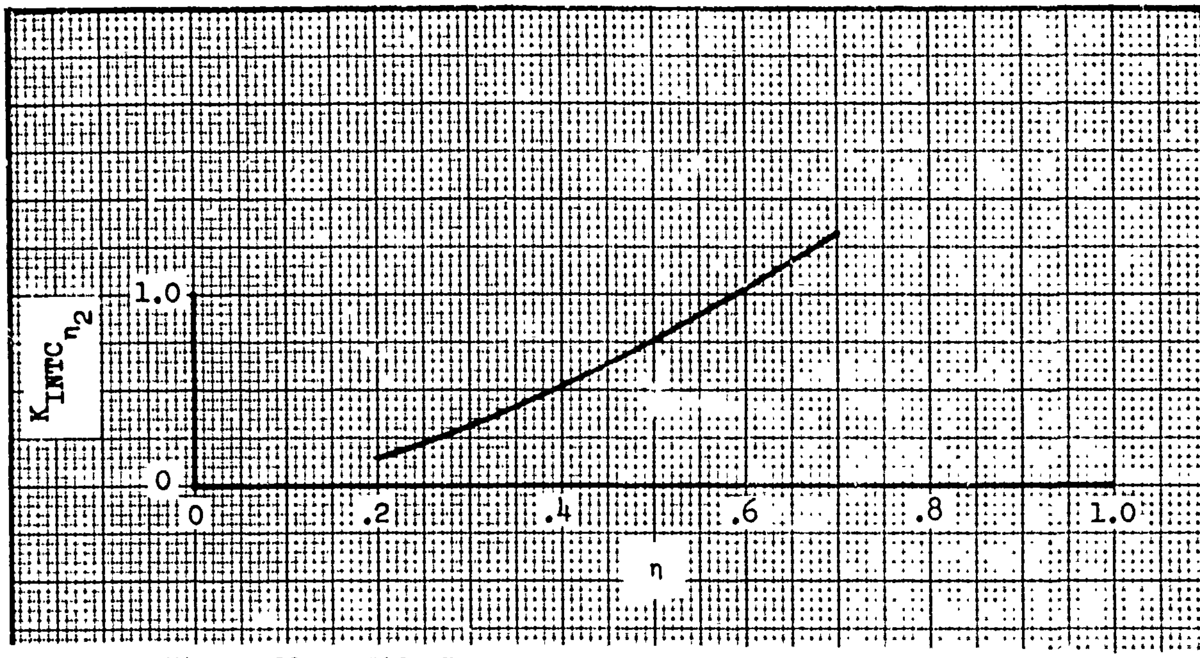

Figure 23. Side Force Slope - K_{INTC_2} Spanwise Correction

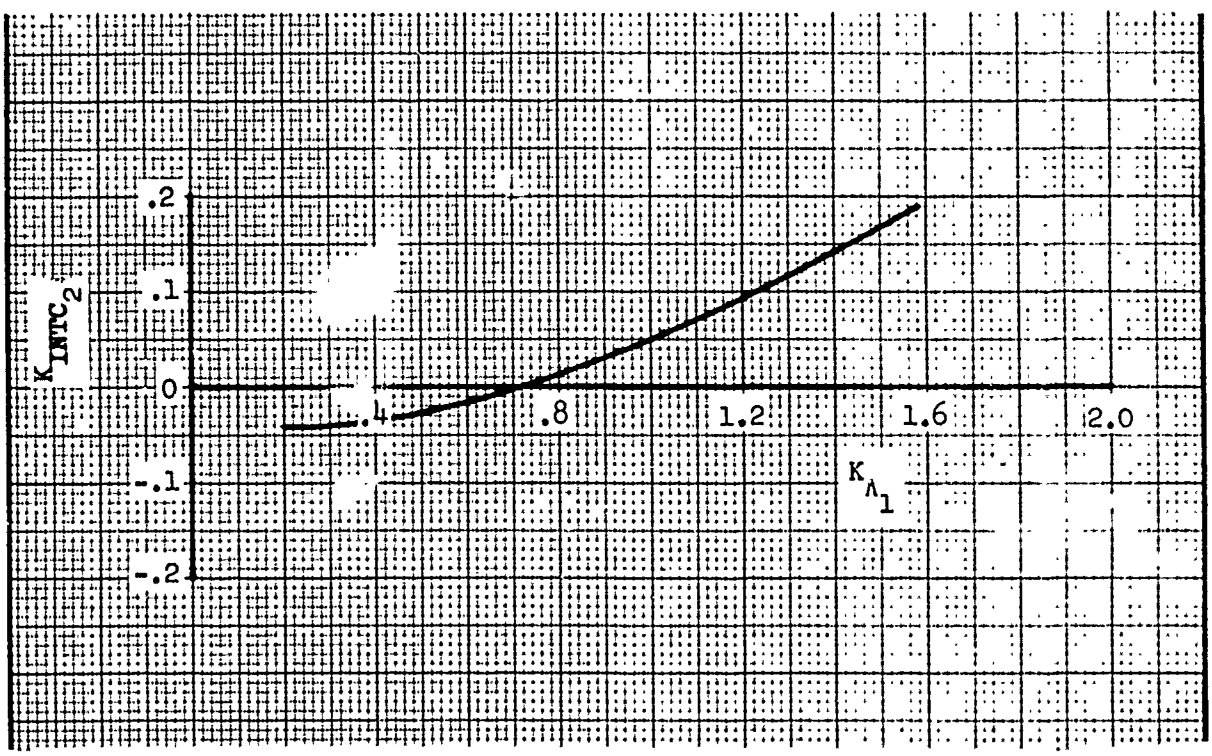

Figure 24. Side Force Slope - K_{INTC} for Mach Break 2

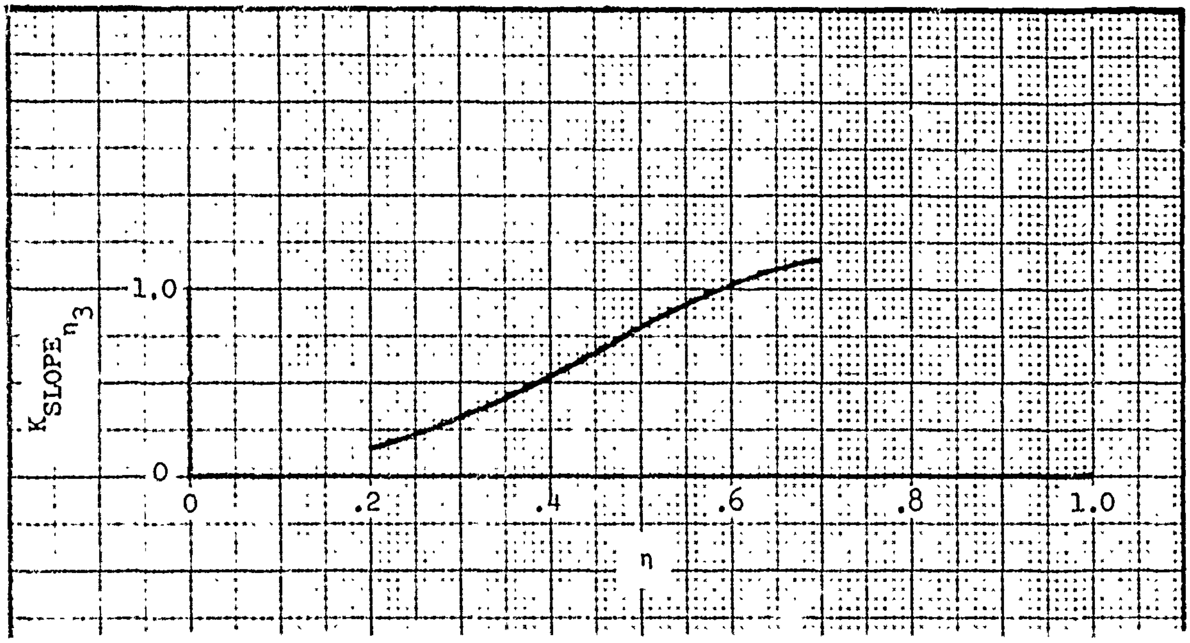

Figure 25. Side Force Slope - K_{SLOPE_3} Spanwise Correction

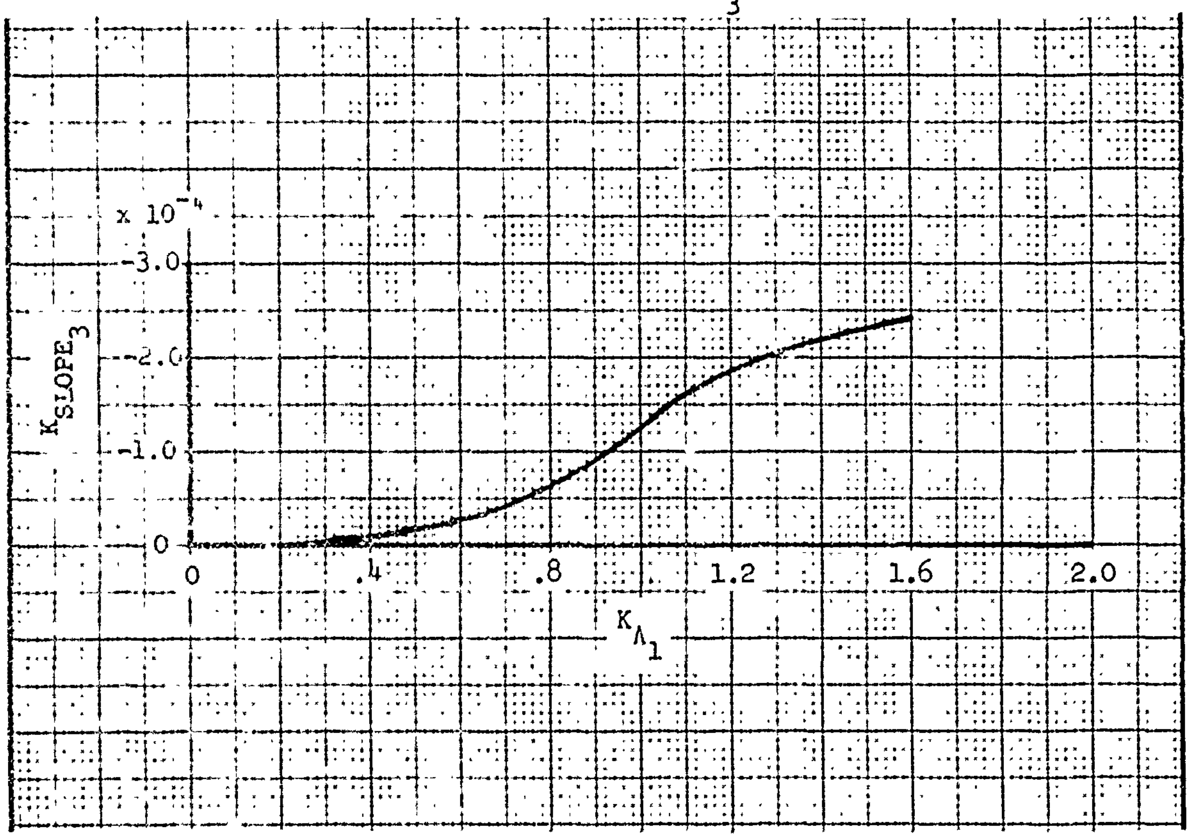

Figure 26. Side Force Slope - K_{SLOPE} for Mach Break 3

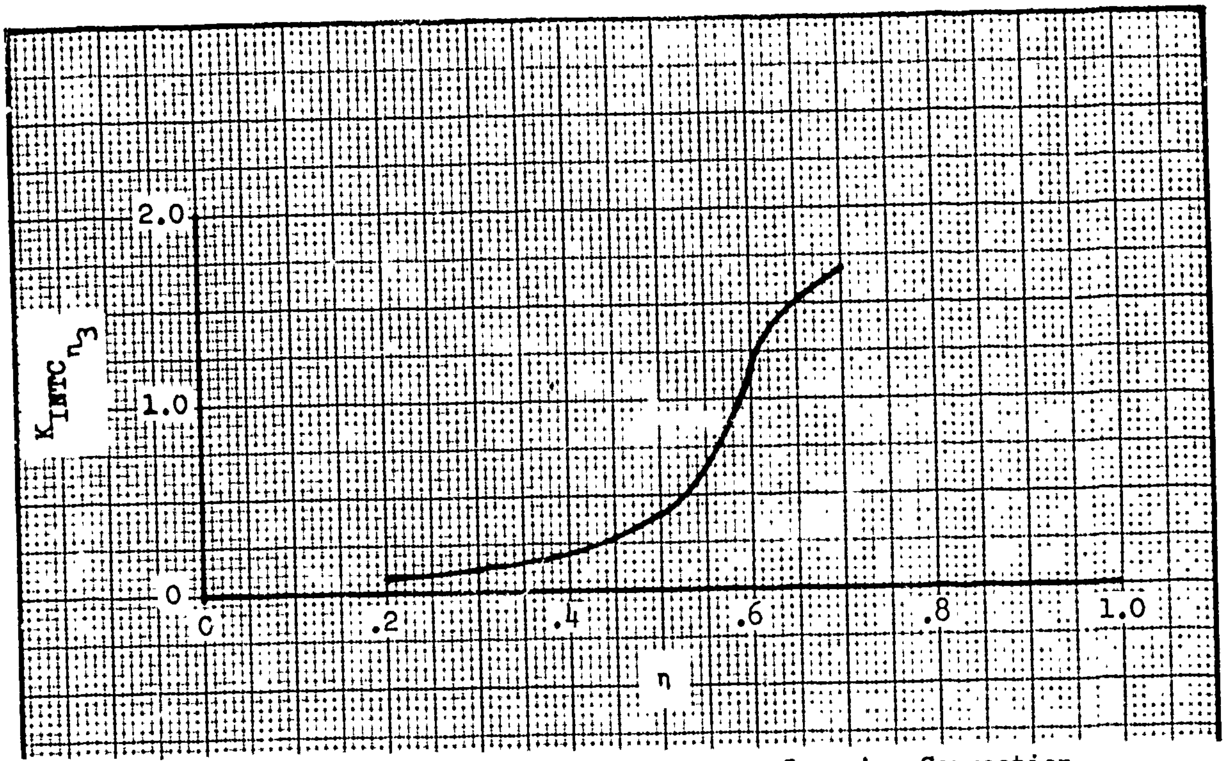

Figure 27. Side Force Slope - K_{INTC_3} Spanwise Correction

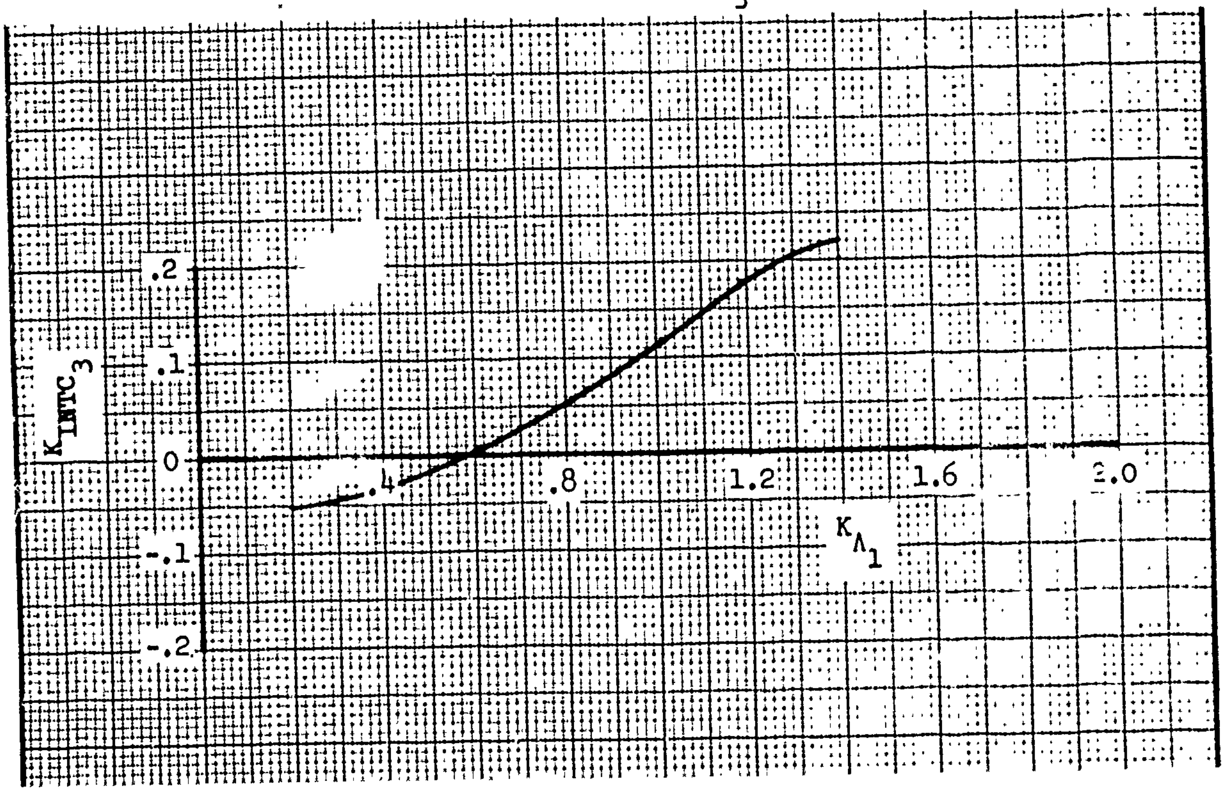

Figure 28. Side Force Slope - K_{INTC} for Mach Break 3

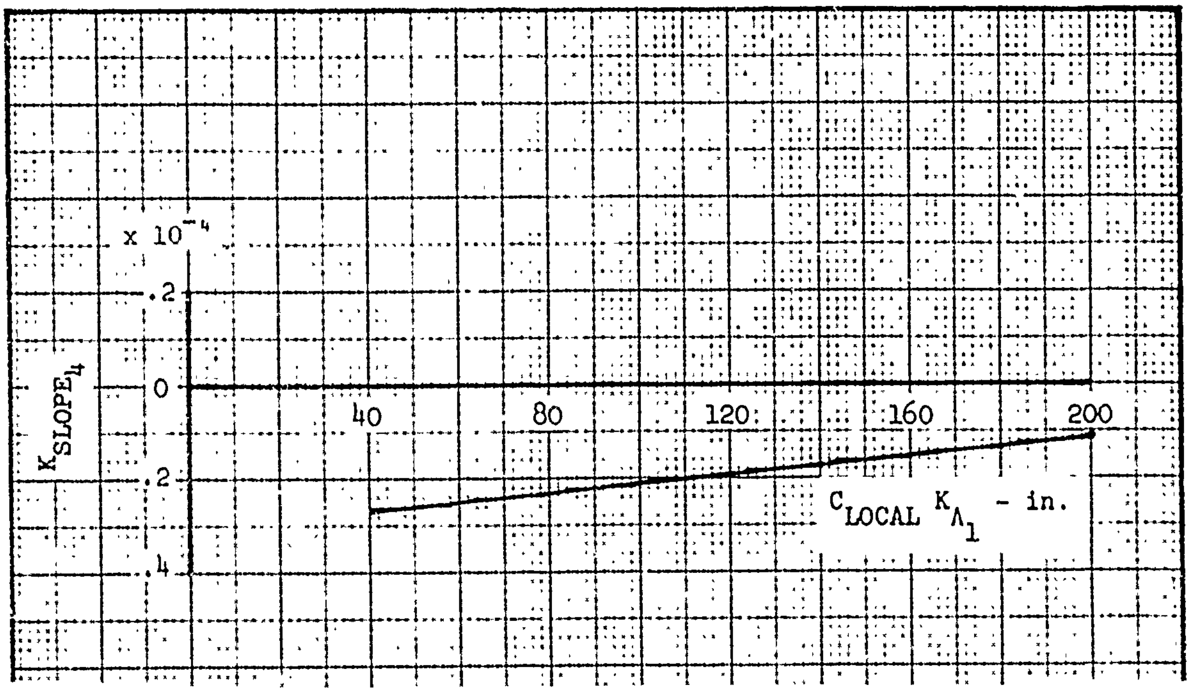

Figure 29. Side Force Slope - K_{SLOPE} for Mach Break 4

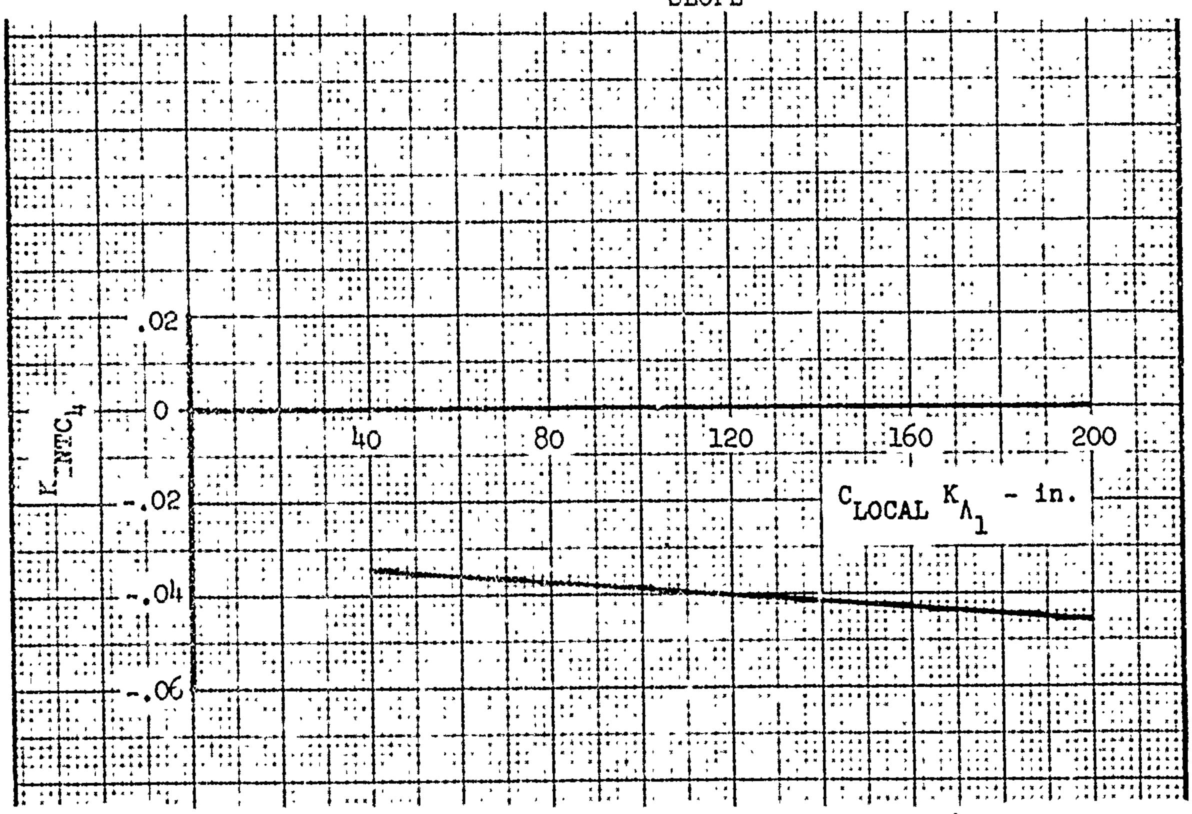

Figure 30. Side Force Slope - K_{INTC} for Mach Break 4

3.1.1.3 Intercept Prediction

The side force intercept, $\left(\frac{SF}{q}\right)_{\alpha=0}$, at M = 0.5 is predicted from the following relationship.

$$\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\ PRED}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}} + \Delta K_{SLOPE_{\ell_{LE}}})(\text{ADJ. FIN SPA}) + K_{INTC_1} + \Delta K_{INTC_{INTF}} + \Delta K_{INTC_{\ell_{LE}}}]\, K_{\Lambda_1} S_{REF}$$

K_{SLOPE_1} - Basic variation of $C_{y_{\alpha=0}}$ with ADJ. FIN SPA, $\frac{1}{in^2}$, Figure 31.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to the interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2}$, Figure 32.

$\Delta K_{Slope_{\ell_{LE}}}$ - Incremental change in K_{SLOPE_1} based on ℓ_{LE}, $\frac{1}{in^2}$, Figure 33.

K_{INTC_1} - Value of $C_{y_{\alpha=0}}$ when ADJ. FIN SPA = 0, Figure 34.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to the interference effect of the fuselage for high wing aircraft, Figure 35.

$\Delta K_{INTC_{\ell_{LE}}}$ - Incremental change in K_{INTC_1} based on ℓ_{LE}, Figure 36.

Example:

Compute the side force intercept, $\left(\frac{SF}{q}\right)_{\alpha=0}$, for a 300-gallon tank on the A-7 center pylon at M = 0.5.

Required for Computation:

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_1} = .811$

$y = 68.2$ in.

$d = 26.5$ in.

$\ell_{LE} = 75.1$ in.

ADJ. FIN SPA = 990 in^2 (Subsection 2.3.1).

$S_{REF} = 3.83\ ft^2$

$K_{SLOPE_1} = -.00073$ - Figure 31

$\Delta K_{SLOPE_{INTF}} = 0$ - Figure 32

$\Delta K_{SLOPE_{\ell_{LE}}} = 0$ - Figure 33

$K_{INTC_1} = .25$ - Figure 34

$\Delta K_{INTC_{INTF}} = 0$ - Figure 35

$\Delta K_{INTC_{\ell_{LE}}} = 0$ - Figure 36

Substituting:

$$\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\PRED}} = [(-.00073)(990) + .25](.811)(3.83) = -1.46\ ft^2$$

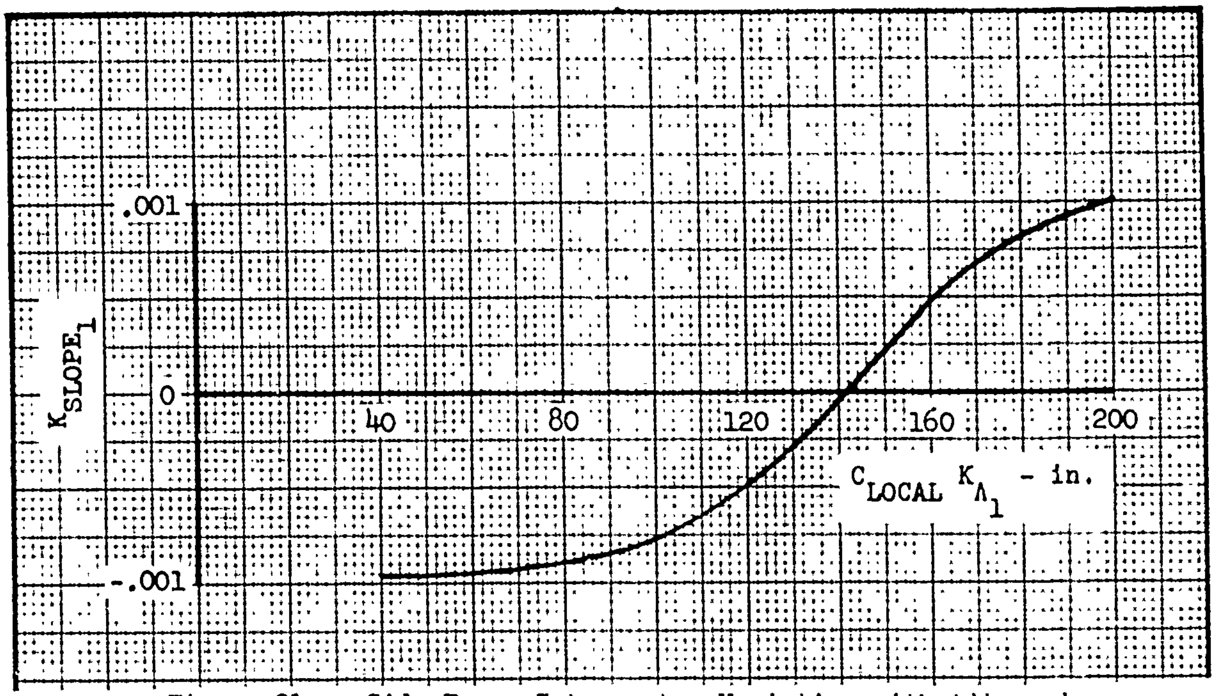

Figure 31. Side Force Intercept - Variation with Adjusted Fin SPA

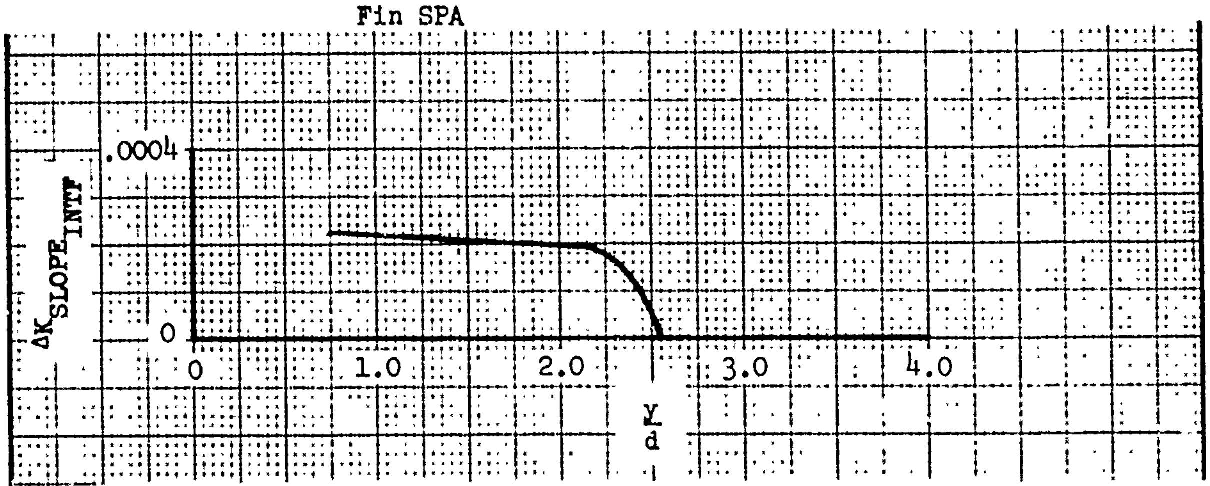

Figure 32. Side Force Intercept - K_{SLOPE} Fuselage Interference Correction

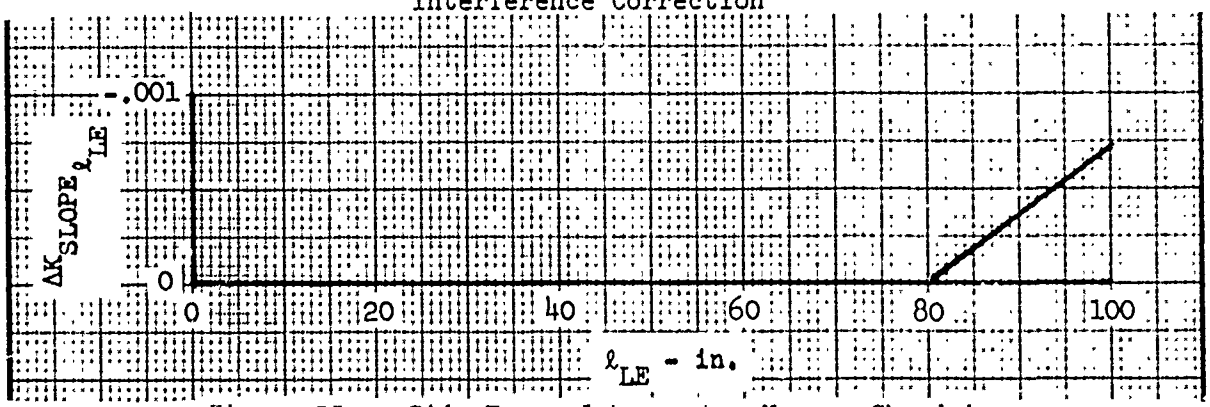

Figure 33. Side Force Intercept - K_{SLOPE} Chordwise Position Correction

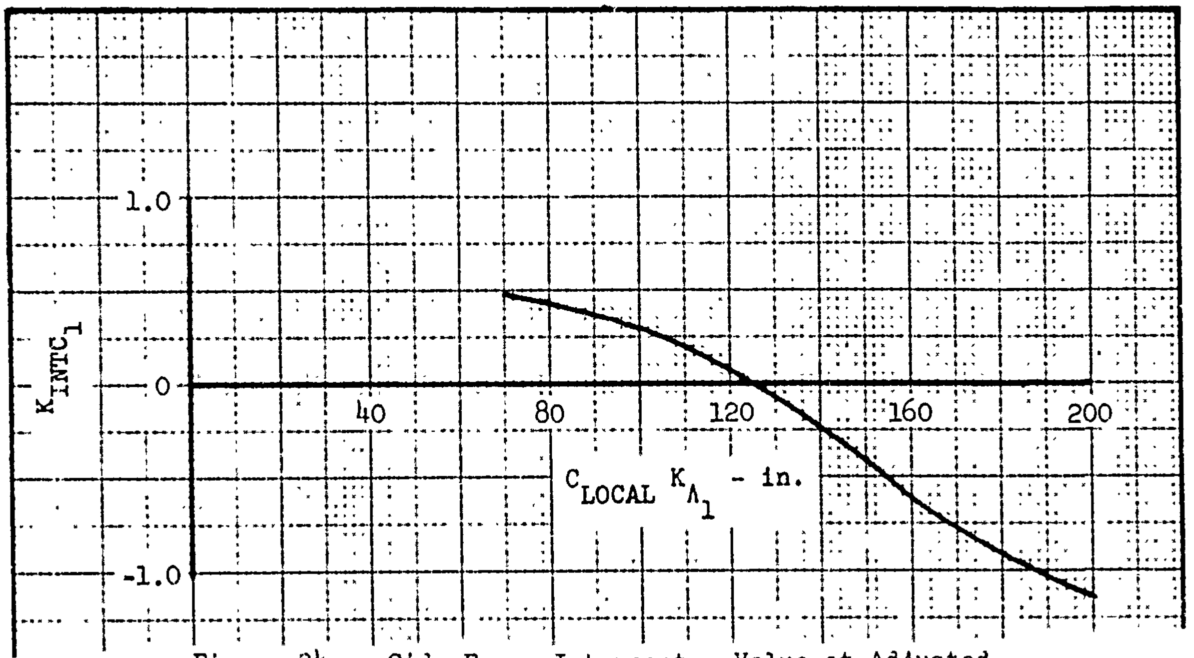

Figure 34. Side Force Intercept - Value at Adjusted Fin SPA =0

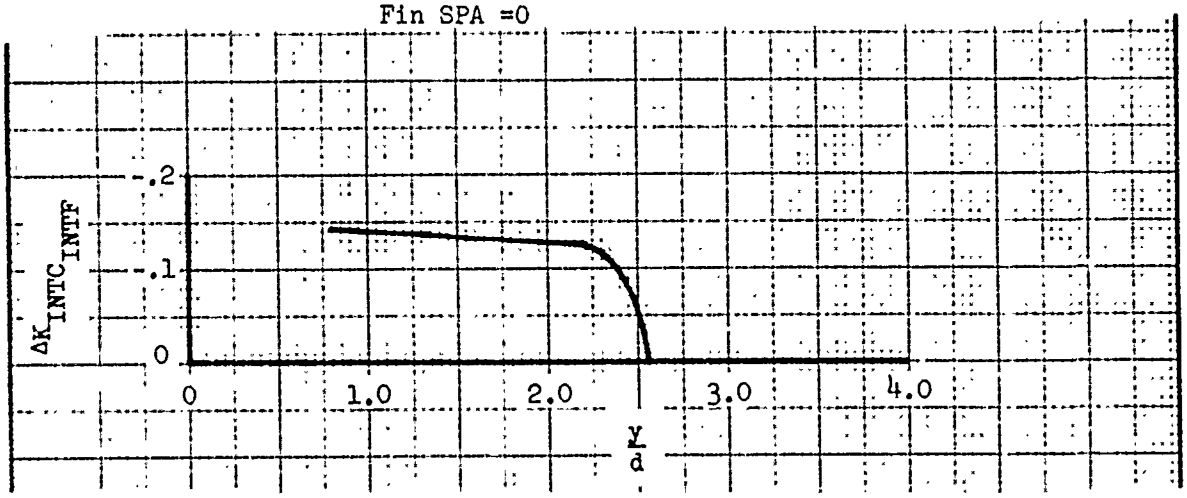

Figure 35. Side Force Intercept - K_{INTC} Fuselage Interference Correction

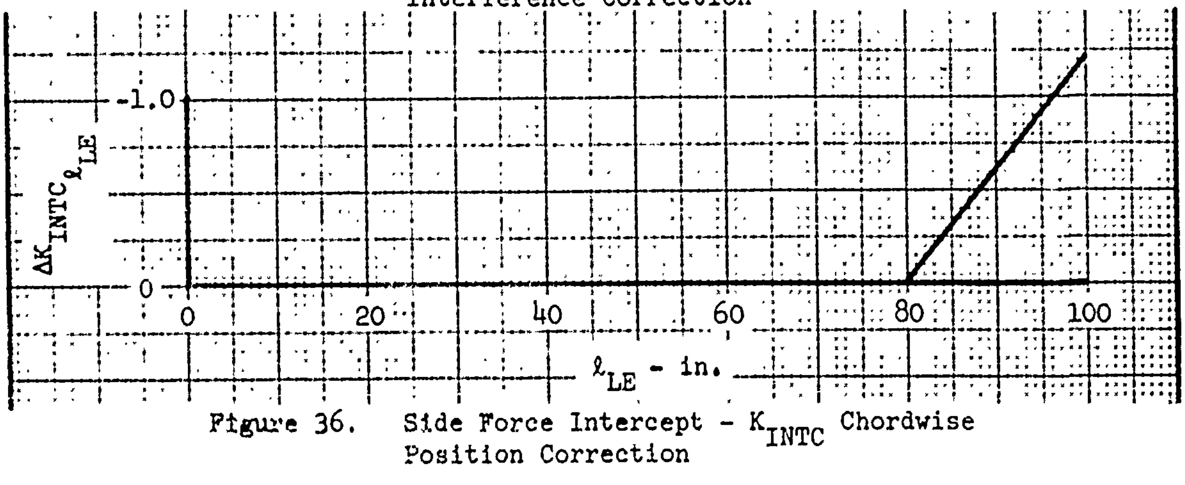

Figure 36. Side Force Intercept - K_{INTC} Chordwise Position Correction

3.1.1.4 Intercept Mach Number Correction

The procedure for calculating the Mach number correction for side force intercept is the same as that presented in Subsection 3.1.1.2 for the side force slope Mach number correction.

The side force intercept variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, and M_3 as in Figure 37.

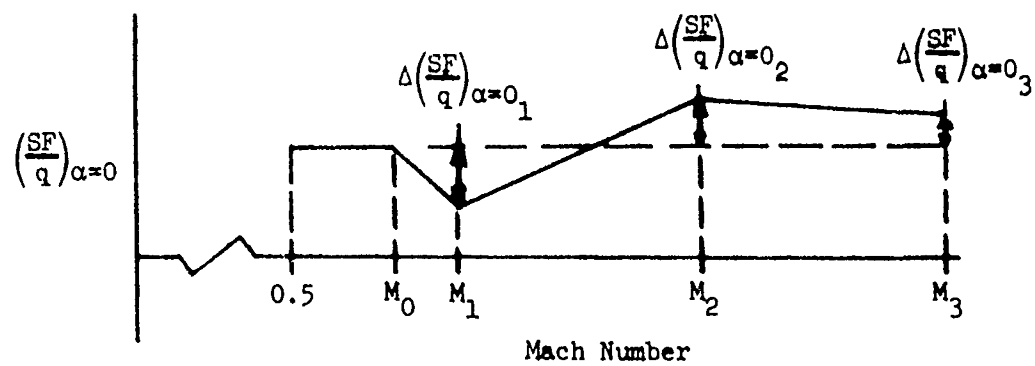

Figure 37. Side Force Intercept - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figure 38 as a function of $C_{LOCAL}K_{\Lambda_1}$. M_0 is the Mach number where the intercept initially deviates from the intercept predicted at M = 0.5. Equations have been developed to predict the delta (incremental) intercept change from that predicted at M = 0.5 at each of the remaining Mach break points (M_1, M_2, M_3). These equations are presented below.

Break 1 (M_1):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0_1} = [K_{SLOPE_1}(\text{ADJ.FIN SPA}) + K_{INTC_1}]K_{\Lambda_1}S_{REF}$$

where:

K_{SLOPE_1} - Variation of $\Delta C_{y_{\alpha=0_1}}$ with ADJ.FIN SPA, $\frac{1}{in^2}$, Figure 39.

ADJ.FIN SPA - Adjusted fin side projected area, in^2, defined in Subsection 2.3.1.

K_{INTC_1} - Value of $\Delta C_{y_{\alpha=0_1}}$ when ADJ.FIN SPA = 0, Figure 40.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

Break 2 (M_2):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF}})(ADJ.FIN\ SPA) + K_{INTC_2} + \Delta K_{INTC_{INTF}}]K_{\Lambda_1} S_{REF}$$

where:

K_{SLOPE_2} - Variation of $\Delta C_{y_{\alpha=0_2}}$ with ADJ.FIN SPA, $\frac{1}{in^2}$, Figure 41.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_2} due to the interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2}$, Figure 42.

K_{INTC_2} - Value of $\Delta C_{y_{\alpha=0_2}}$ when ADJ.FIN SPA = 0, Figure 43.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_2} due to the interference effect of the fuselage for high wing aircraft, Figure 44.

Break 3 (M_3):

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0_3} = [K_{SLOPE_3}(ADJ.FIN\ SPA) + K_{INTC_3}]K_{\Lambda_1} S_{REF}$$

where:

K_{SLOPE_3} - Variation of $\Delta C_{y_{\alpha=0_3}}$ with ADJ.FIN SPA, $\frac{1}{in^2}$, Figure 45.

K_{INTC_3} - Value of $\Delta C_{y_{\alpha=0_3}}$ when ADJ.FIN SPA = 0, Figure 46.

To compute $\left(\frac{SF}{q}\right)_{\alpha=0}$ at M = x, first determine from Figure 38 between which Mach number break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\left(\frac{SF}{q}\right)_{\alpha=0}$ at M = x from the expression below.

$$\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{SF}{q}\right)_{\substack{\alpha=0\\PRED}} + \Delta\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\LOW}} + \left(\frac{x - M_{LOW}}{M_{HI}-M_{LOW}}\right) \left[\Delta\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\HI}} - \Delta\left(\frac{SF}{q}\right)_{\alpha_{LOW}}\right]$$

If $x \leq M_0$, $\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\M=x}}$ will be the value obtained in Subsection 3.1.1.3 (the initial term in the above equation, $\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\PRED}}$).

A numerical example is included in Subsection 3.1.1.2 that illustrates the application of the above equation.

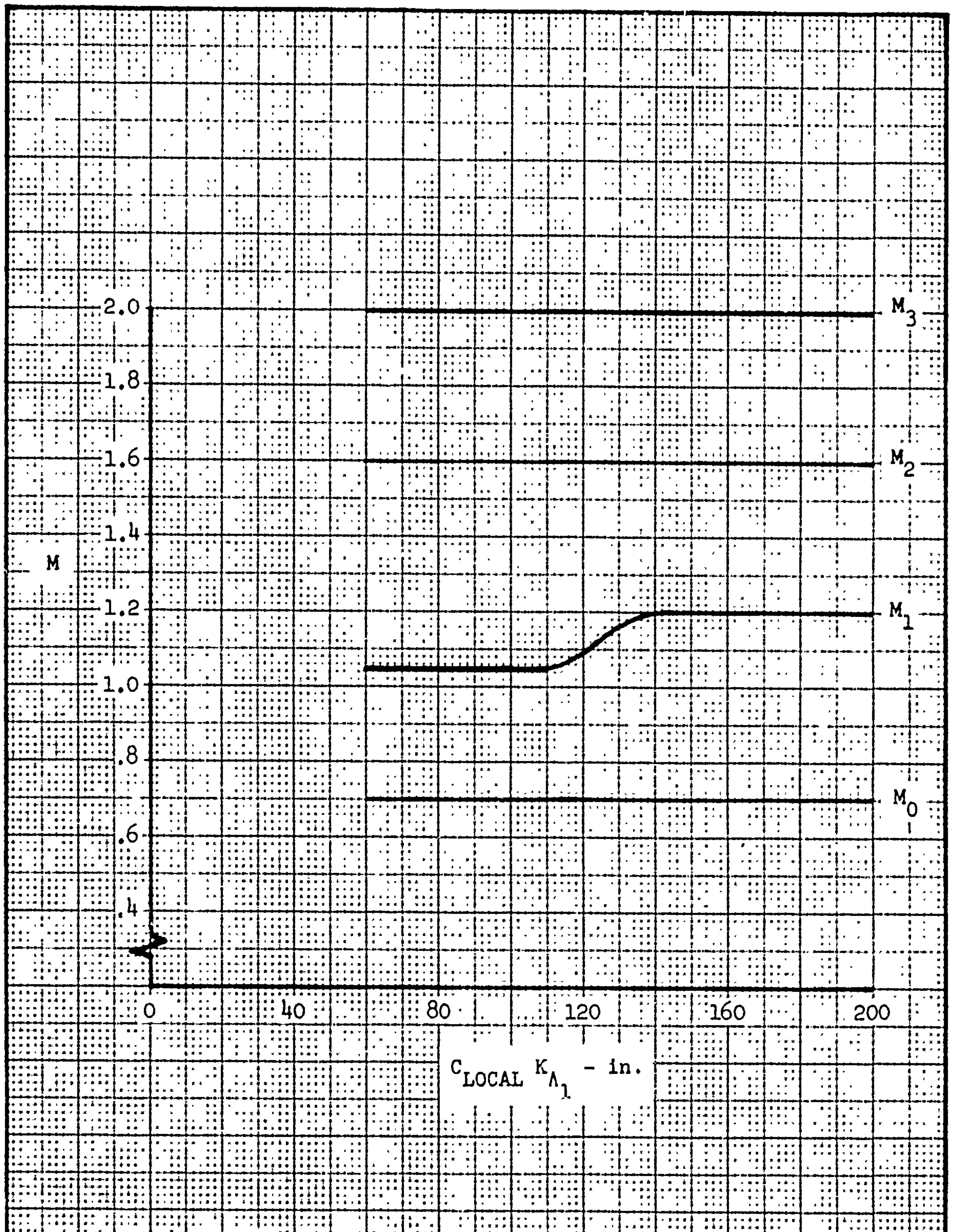

Figure 38. Side Force Intercept - Mach Number Break Points

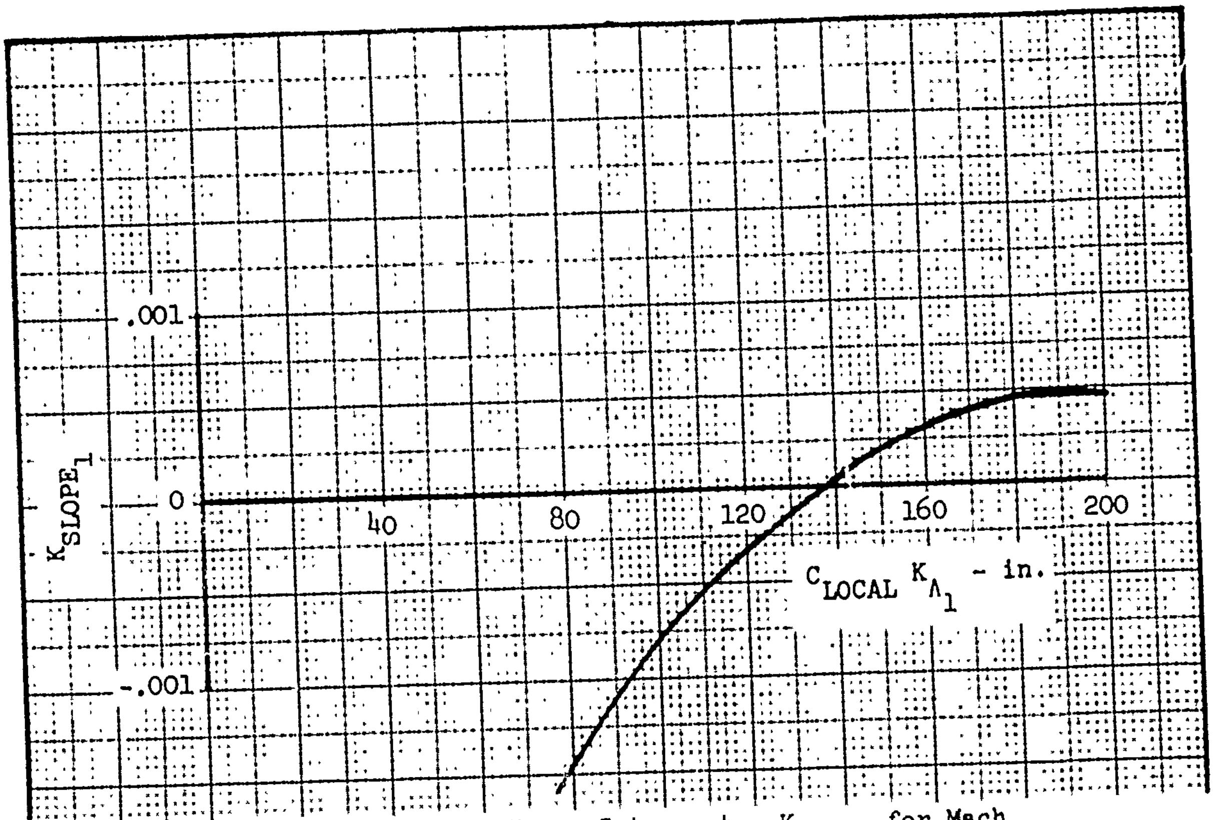

Figure 39. Side Force Intercept - K_{SLOPE} for Mach Break 1

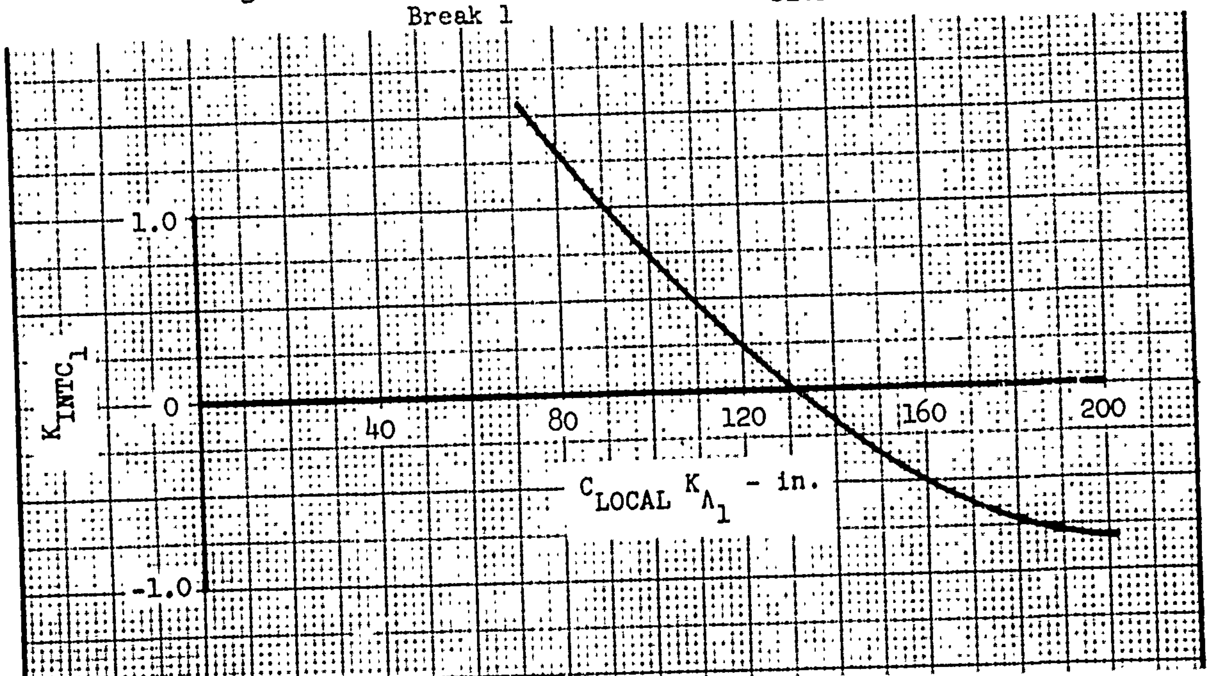

Figure 40. Side Force Intercept - K_{INTC} for Mach Break 1

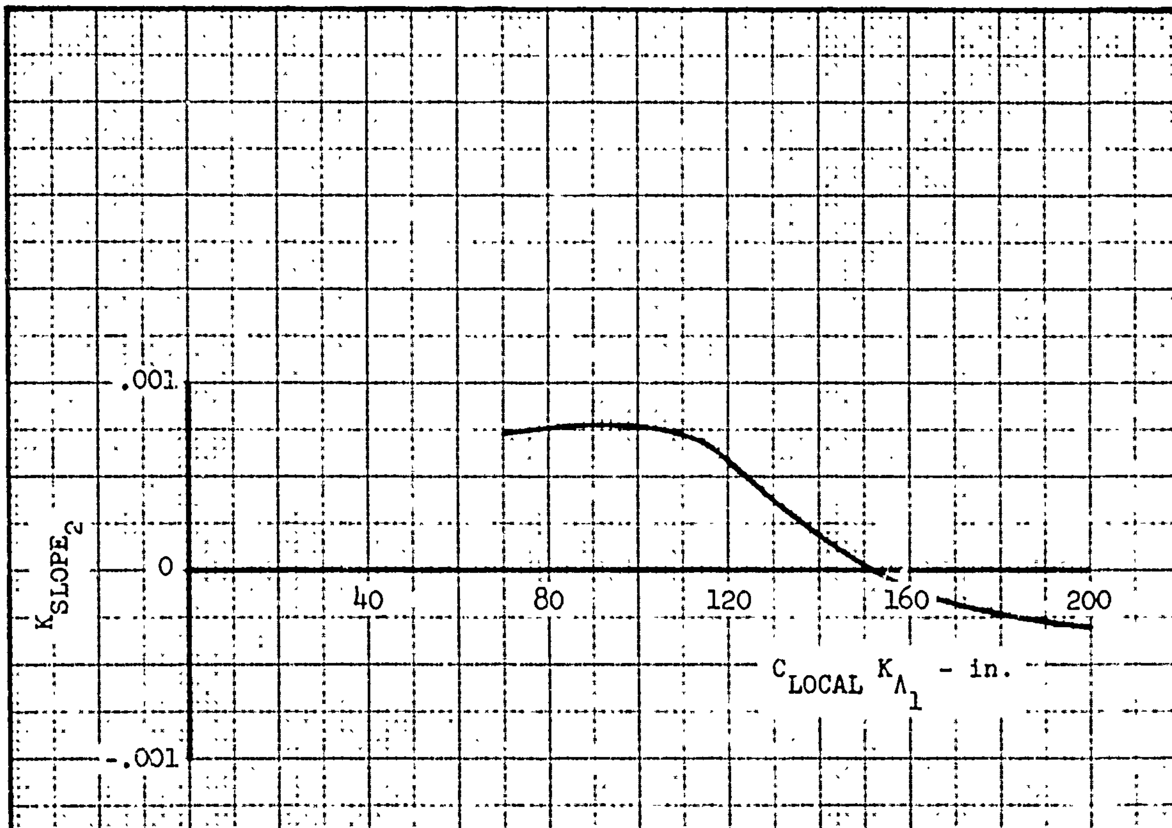

Figure 41. Side Force Intercept - K_{SLOPE} for Mach Break 2

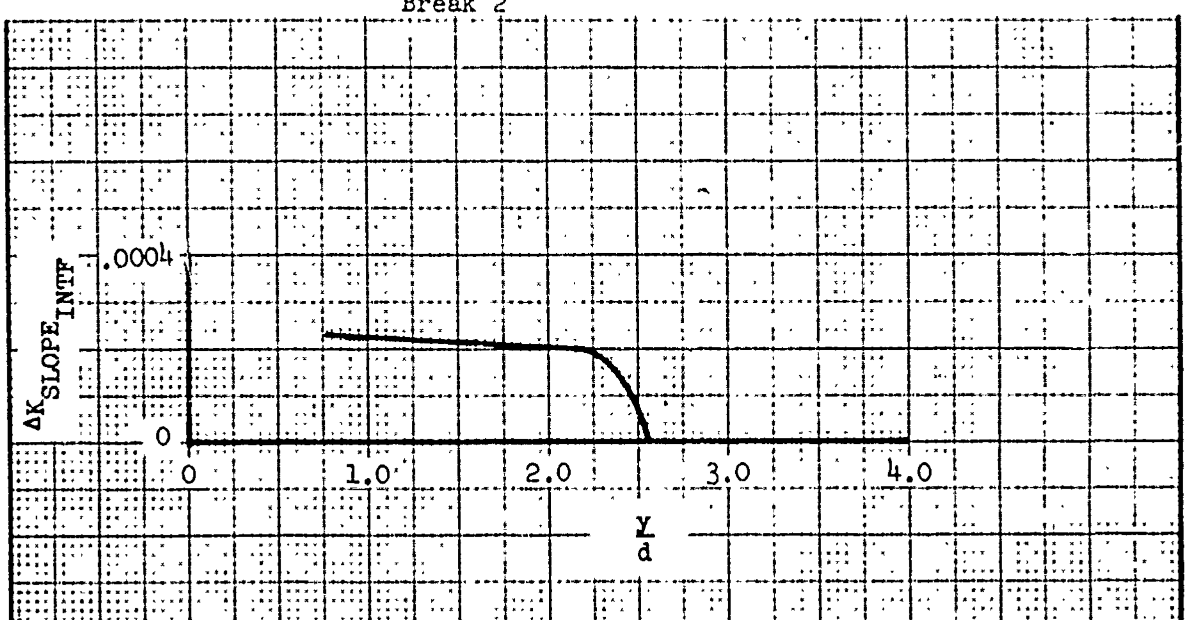

Figure 42. Side Force Intercept - K_{SLOPE} Fuselage Interference Correction

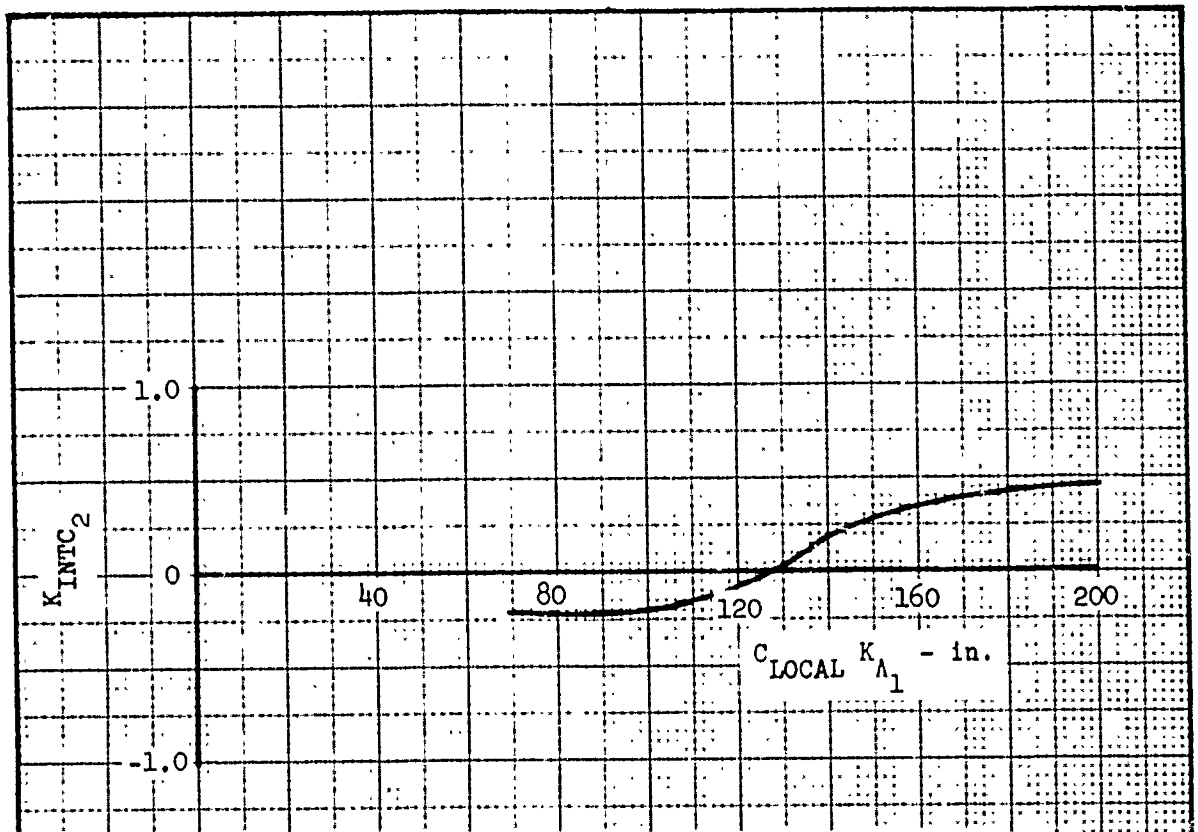

Figure 43. Side Force Intercept - K_{INTC} for Mach Break 2

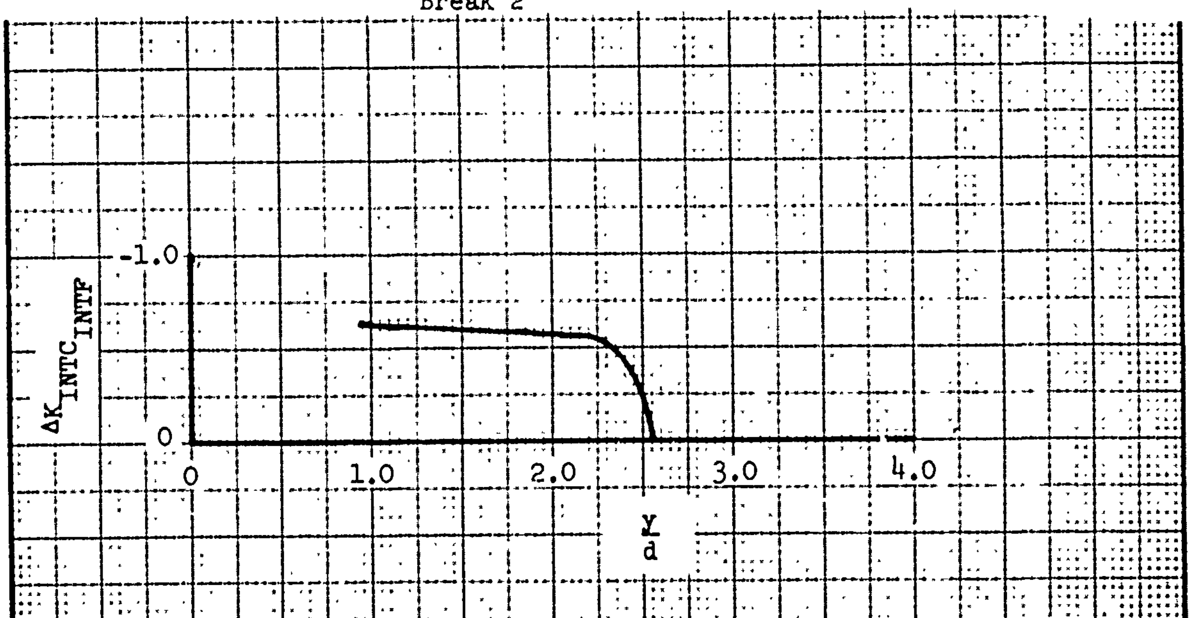

Figure 44. Side Force Intercept - K_{INTC} Fuselage Interference Correction

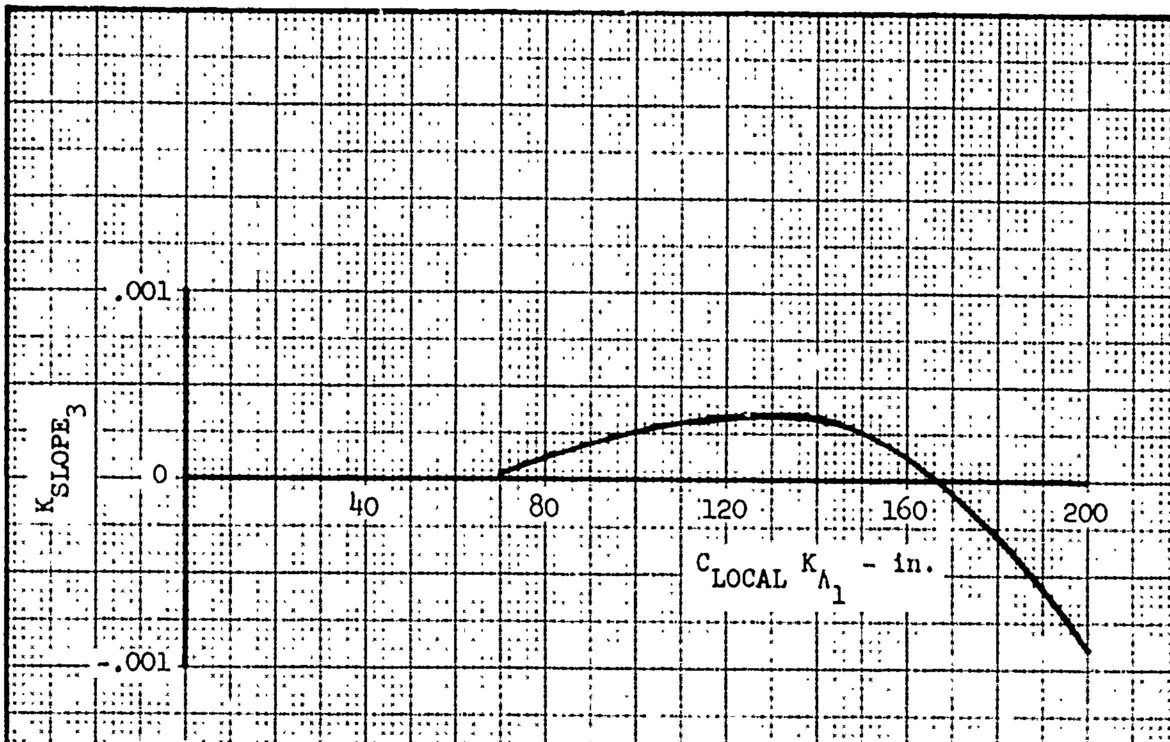

Figure 45. Side Force Intercept - K_{SLOPE} for Mach Break 3

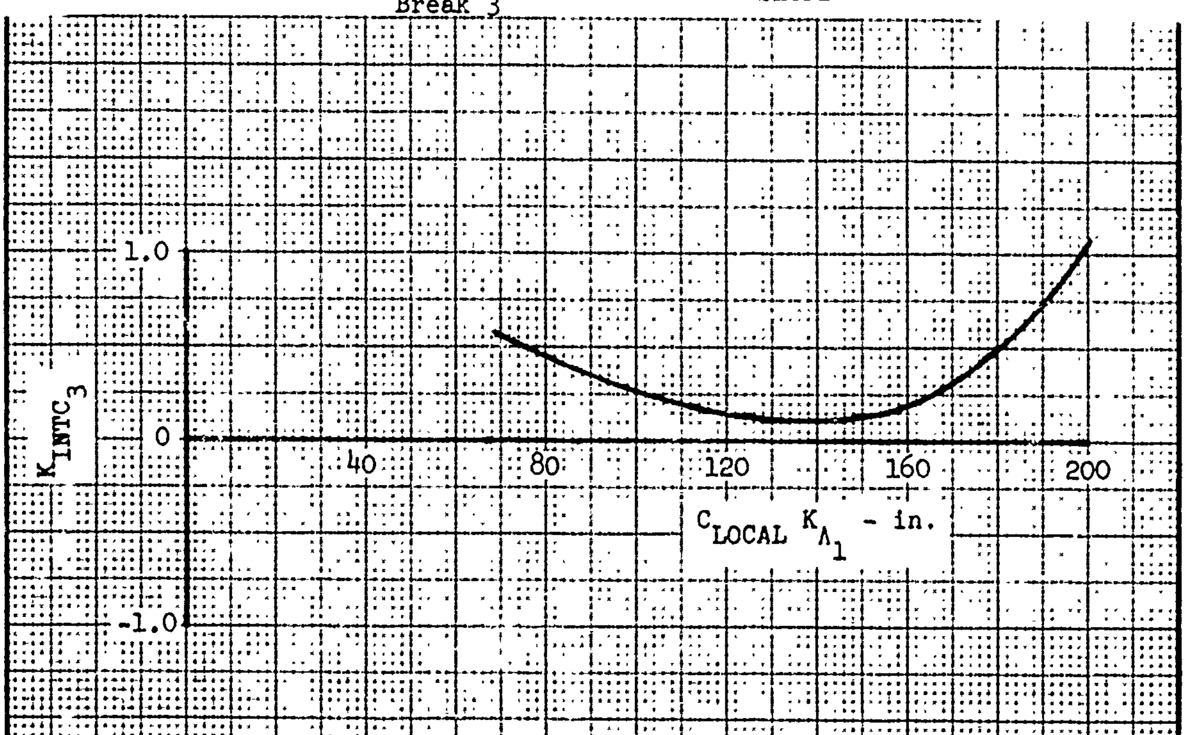

Figure 46. Side Force Intercept - K_{INTC} for Mach Break 3

3.1.2 Increment - Aircraft Yaw

The store incremental side force due to aircraft yaw is obtained from the difference between the yawed pitch polar and the zero-yaw pitch polar data, as outlined in Section III. The incremental side force slope, $\Delta\left(\frac{SF}{q}\right)_{\alpha}$, and intercept, $\Delta\left(\frac{SF}{q}\right)_{\alpha=0}$, thus obtained are essentially linear with aircraft yaw angle; therefore, the incremental slope and intercept equations are derived and presented per degree of store yaw angle. The incremental airloads due to aircraft yaw are referenced to the coordinate system presented in Subsection 2.3.1.1.

To compute the incremental side force slope, $\Delta\left(\frac{SF}{q}\right)_{\alpha}$, the following equation is used.

$$\Delta\left(\frac{SF}{q}\right)_{\alpha} = \Delta\left(\frac{SF}{q}\right)_{\alpha_{\beta_S}} \cdot \beta_S$$

where:

$\Delta\left(\frac{SF}{q}\right)_{\alpha_{\beta_S}}$ - Incremental side force slope per degree β_S as obtained by the methods presented in the following sections.

β_S - Store yaw angle, deg. Equal to $+\Psi_{A/C}$ for right wing store installations or $-\Psi_{A/C}$ for left wing store installations.

The equation for incremental side force intercept, $\Delta\left(\frac{SF}{q}\right)_{\alpha=0}$ is similar.

3.1.2.1 Slope Prediction

The equation to compute incremental side force slope per degree β_S, $\Delta\left(\frac{SF}{q}\right)_{\alpha_{\beta_S}}$, is given below.

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_{\beta_S}} = [K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}} + K_{\ell_{LE/L}} (\Delta K_{SLOPE_{\ell_{LE/L}}})].$$

(ADJ. SPA)

where:

K_{SLOPE_1} - Variation of incremental side force slope per degree β_S with ADJ.SPA, $\frac{ft^2}{in^2 - deg^2}$, Figure 47.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{ft^2}{in^2 - deg^2}$, Figure 48.

$\Delta K_{SLOPE_{\ell_{LE/L}}}$ - Incremental change in K_{SLOPE_1} as a function of $\ell_{LE/L}$ presented versus Mach number, $\frac{ft^2}{in^2 - deg^2}$, Figure 50.

$K_{\ell_{LE/L}}$ - Correction factor based on store length forward of the wing leading edge divided by total store length, Figure 49.

ADJ. SPA - Total store adjusted side projected area, in^2, from Subsection 2.3.2.

Example: Compute $\Delta\left(\frac{SF}{q}\right)_\alpha$ for a 300-gallon tank on the A-7 center pylon at M = 0.5 and $\beta_S = 4°$.

Required for Computation:

$\beta_S = 4°$

$M = 0.5$

$\eta' = .270$

$\ell_{LE/L} = .330$

ADJ. SPA = 6036.9 in^2 from Subsection 2.3.2.1

$K_{SLOPE_1} = 4 \times 10^{-8}$ - Figure 47, $+\beta_S$ curve.

$\Delta K_{SLOPE_{INTF}} = 0.0$ - Figure 48, $+\beta_S$ curve

$K_{\ell_{LE/L}} = 0.0$ - Figure 49

$\Delta K_{SLOPE_{\ell_{LE/L}}} = 4.8 \times 10^{-6}$ - Figure 50, $+\beta_S$ curve

substituting,

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_{\beta_S}} = (4.0 \times 10^{-6} + 0.0 + 0.0(4.8 \times 10^{-6}))6036.9$$

$$= .0241 \ \frac{ft^2}{deg^2}$$

and using the equation from Subsection 3.1.2

$$\Delta\left(\frac{SF}{q}\right)_{\alpha} = \Delta\left(\frac{SF}{q}\right)_{\alpha_{\beta_S}} \cdot \beta_S$$

$$\Delta\left(\frac{SF}{q}\right)_{\alpha} = (.0241)4 = .0964 \ \frac{ft^2}{deg}$$

Figure 47. Incremental Side Force Slope Due to Yaw - Variation with Adjusted SPA

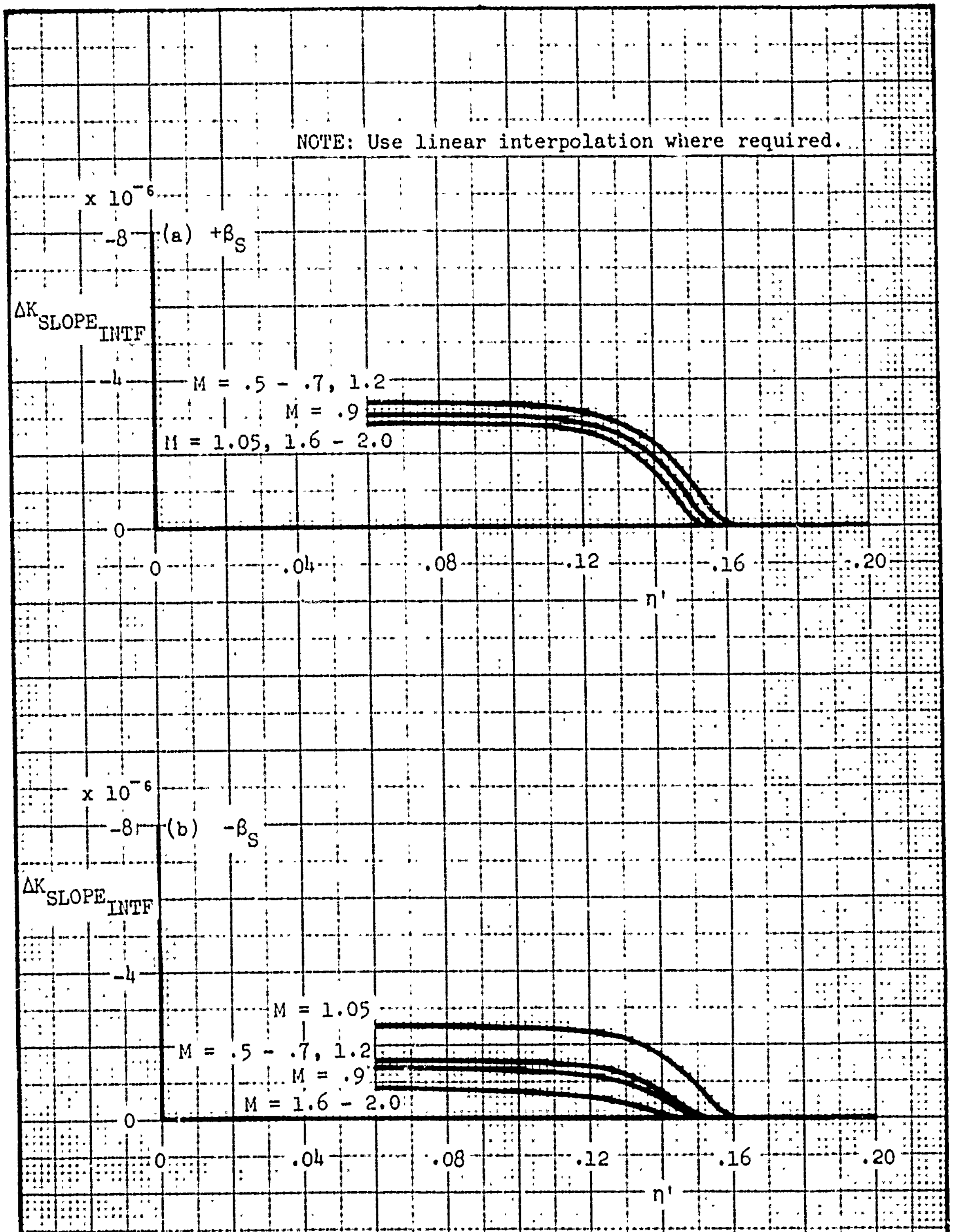

Figure 48. Incremental Side Force Slope Due to Yaw - K_{SLOPE} Correction for Fuselage Interference

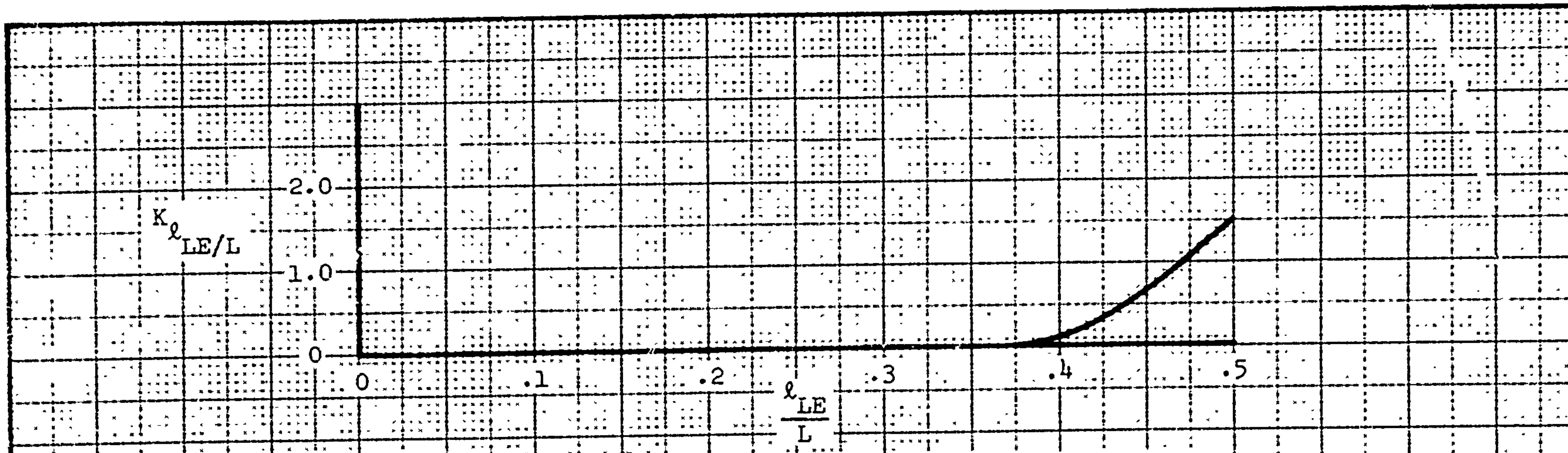

Figure 49. Incremental Side Force Slope Due to Yaw - Chordwise Correction

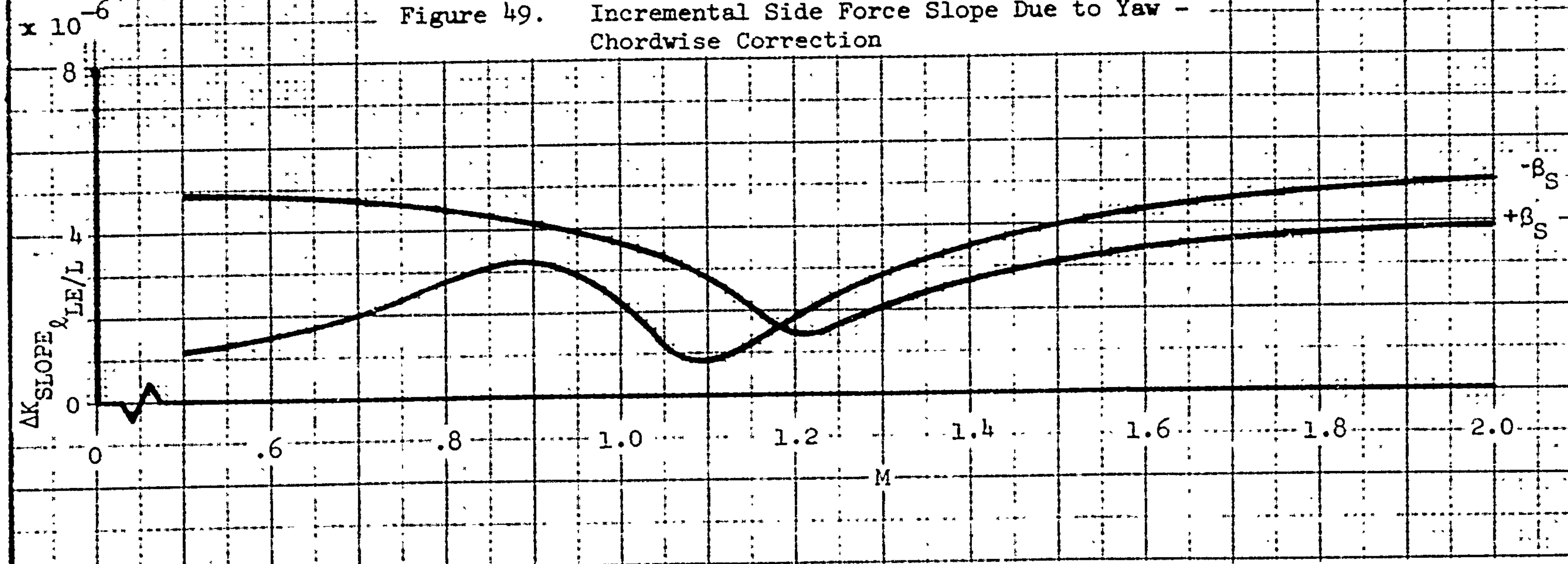

Figure 50. Incremental Side Force Slope Due to Yaw - K_{SLOPE} Chordwise Position Correction

3.1.2.2 Intercept Prediction

The equation for incremental side force intercept per degree β_S, $\Delta\left(\frac{SF}{q}\right)_{\alpha=0_{\beta_S}}$, is presented below.

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0_{\beta_S}} = K_{SLOPE_1}(ADJ.NOSE\ SPA) + K_{INTC_1} + \Delta K_{INTC_{INTF}}$$

where:

K_{SLOPE_1} - Variation of incremental side force intercept per degree β_S with ADJ.NOSE SPA, $\frac{ft^2}{in^2. - deg^2.}$, Figure 51.

ADJ.NOSE SPA - Store adjusted nose side projected area, in^2., from Subsection 2.3.2.

K_{INTC_1} - Value of incremental side force intercept per degree β_S when ADJ. NOSE SPA = 0, $\frac{ft^2}{deg}$, Figure 52.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC} due to interference effect of the fuselage for high wing aircraft, $\frac{ft^2}{deg}$, Figure 53.

Example: Compute the value of $\Delta\left(\frac{SF}{q}\right)_{\alpha=0}$ for a 300-gallon tank on the A-7 center pylon at M = 0.5 and $\beta_S = -4°$.

Required for Computation:

$\beta_S = -4°$

$M = 0.5$

$\eta' = .270$

ADJ.NOSE SPA = 3109 in^2 from Subsection 2.3.2

$$K_{SLOPE_1} = .7 \times 10^{-5} \quad \text{- Figure 51, } -\beta_S \text{ curve}$$

$$K_{INTC} = .318 \quad \text{- Figure 52, } -\beta_S \text{ curve}$$

$$\Delta K_{INTC_{INTF}} = 0.0 \quad \text{- Figure 53, } -\beta_S \text{ curve}$$

Substituting,

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0_{\beta_S}} = (.7 \times 10^{-5})(3109) + .318 + 0.0 = .339 \frac{ft^2}{deg}$$

and substituting into the equation from Subsection 3.1.2,

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0} = \Delta\left(\frac{SF}{q}\right)_{\alpha=0_{\beta_S}} \cdot \beta_S = (.339)(-4) = -1.356 \text{ ft}^2$$

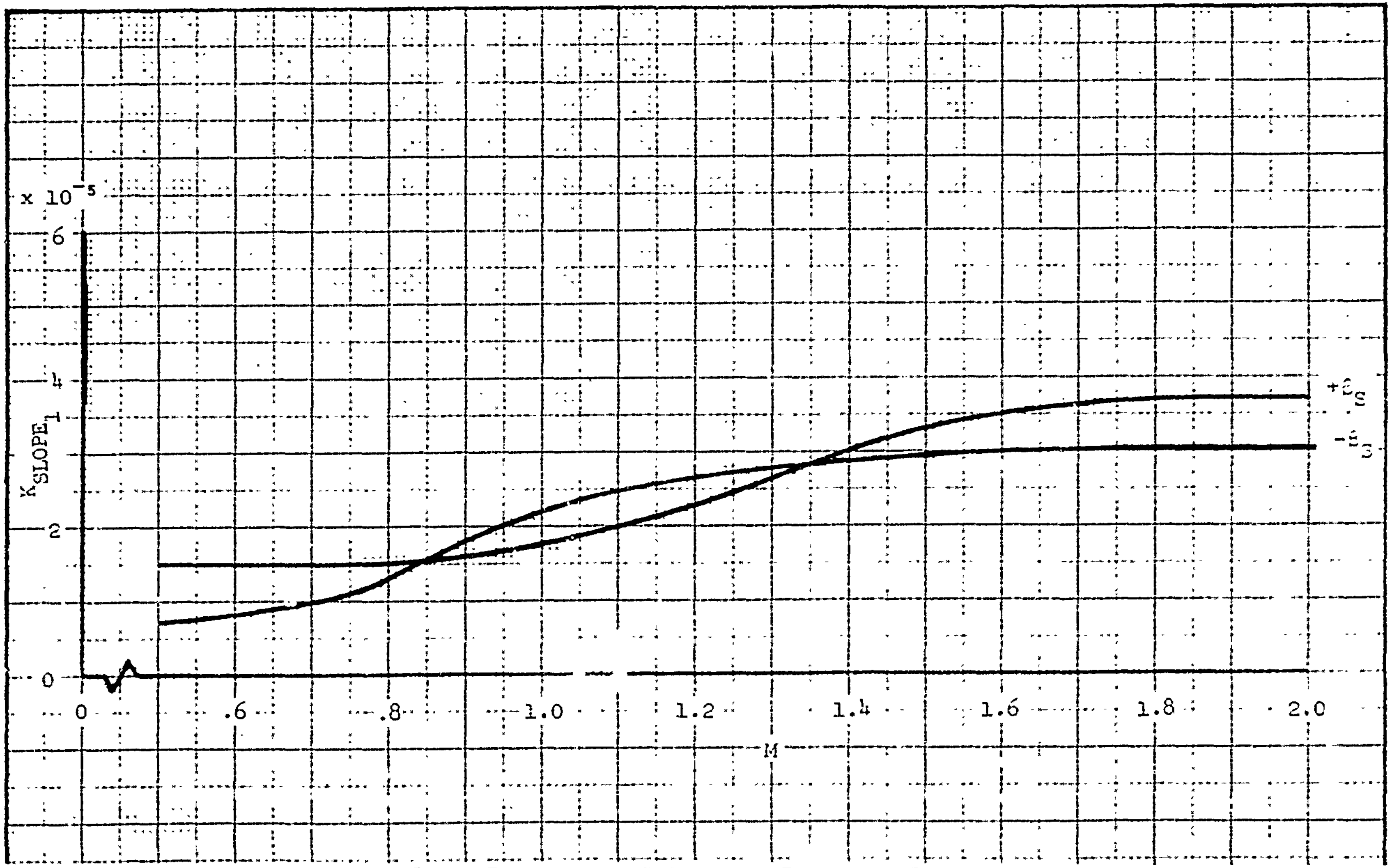

Figure 51. Incremental Side Force Intercept Due to Yaw - Variation with Adjusted Nose SPA

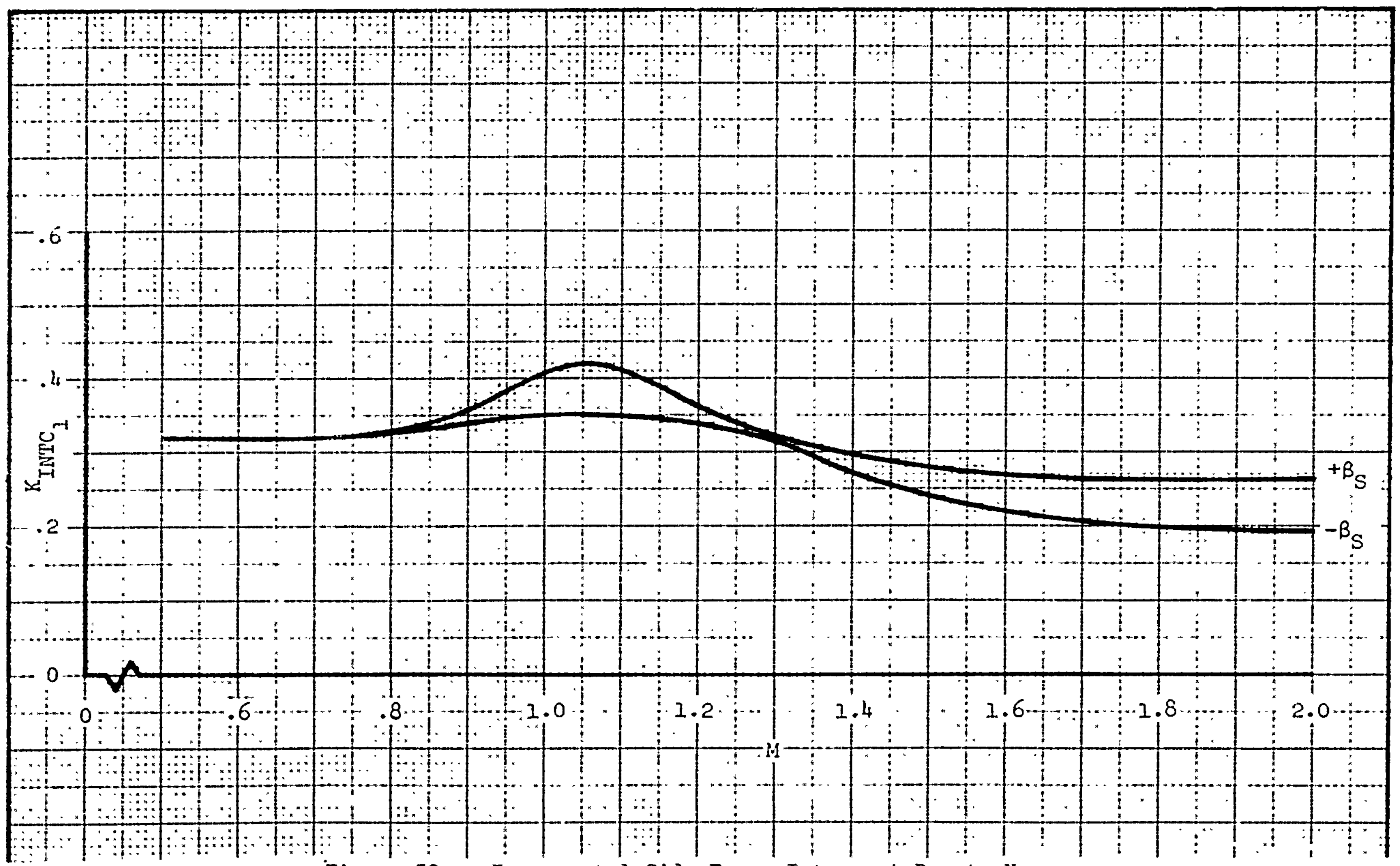

Figure 52. Incremental Side Force Intercept Due to Yaw - Value at Adjusted Nose SPA = 0

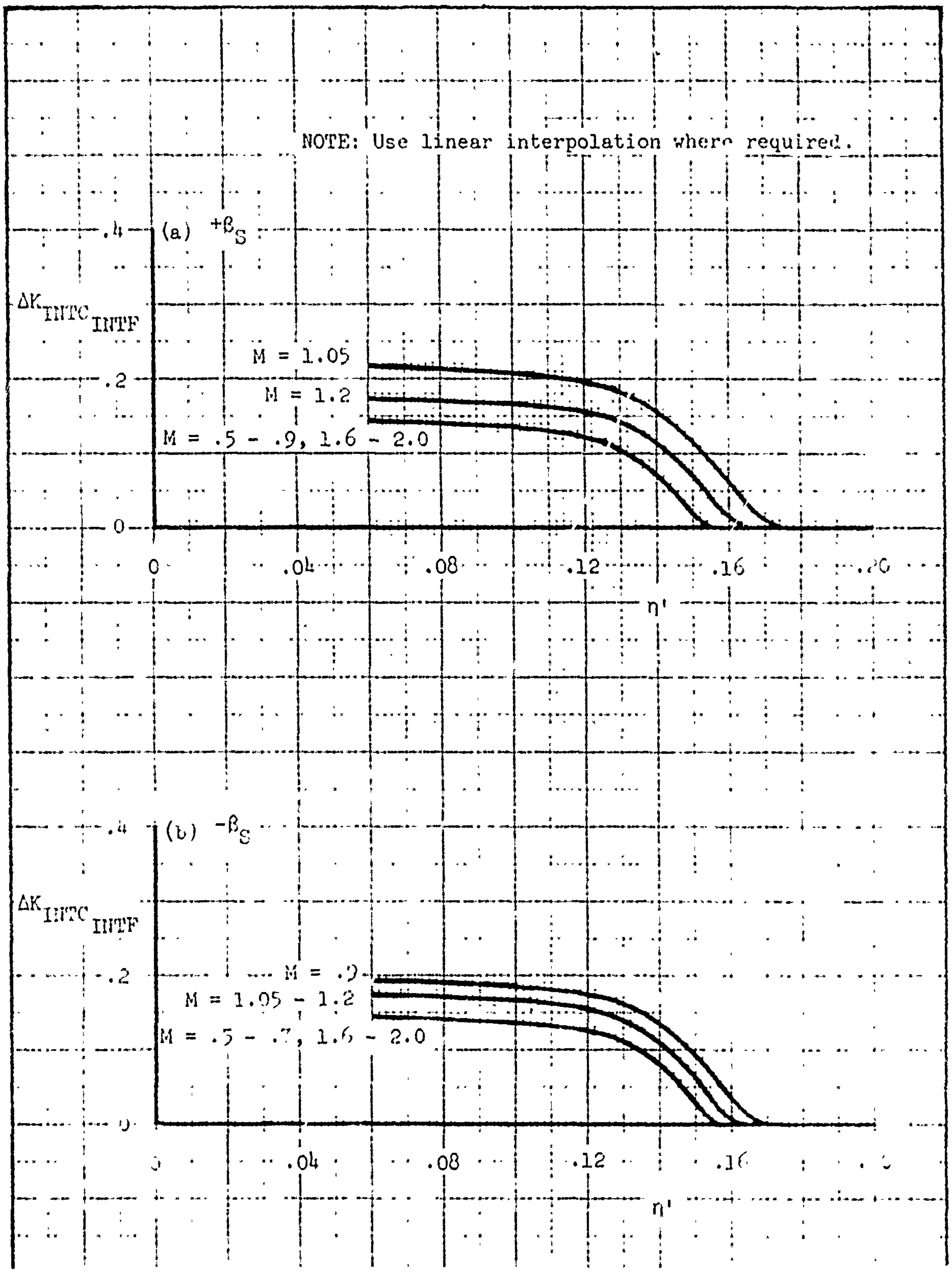

Figure 53. Incremental Side Force Intercept Due to Yaw - K_{INTC} Fuselage Interference Correction

3.1.3 Increment - Adjacent Store Interference

The prediction of incremental side force acting on a subject store due to an interfering store has been developed and presented for two major cases of interfering store location, (1) inboard and (2) outboard of the subject store. When interfering stores are located both inboard and outboard of the subject store, the incremental side force is obtained by summing the values calculated separately for the inboard and outboard cases.

In the prediction equations of the following sections, several geometric relations between the subject store and the interfering store are introduced. Figure 54 illustrates these relations, while definitions of the terms are as follows:

d - Diameter of the subject store, ft.

d_{INTF} - Effective diameter of the interfering store, ft. For a single store the effective diameter equals the physical diameter; for multiple carriage stores the effective diameter equals $\sqrt{Nd^2}$ where N is the number of stores exposed in the front view (3 maximum) and d is the diameter of a single store.

x_{INTF} - Nose overlap distance, in. Distance from the subject store nose to the interfering store nose as measured along a line parallel to the subject store longitudinal axis, positive aft. For MER carriage, x_{INTF} is measured from the nose of the forward store cluster.

y_{INTF} - Store separation distance, in. Minimum lateral clearance between the subject store and the interfering store as measured in the plan view.

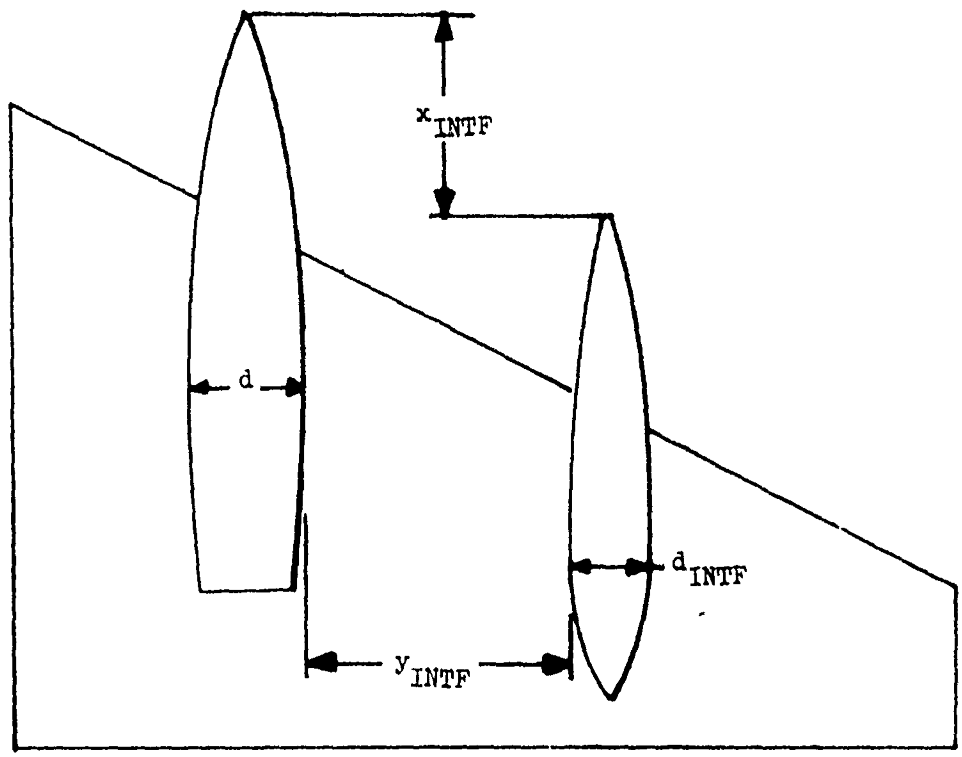

Figure 54. Incremental Side Force Slope Due to Interference - Pictorial Description of Geometric Relations

3.1.3.1 Slope Prediction

The equation to predict incremental side force slope due to adjacent store interference, $\Delta\left(\frac{SF}{q}\right)_{\alpha_{INTF}}$, is given by the following expression.

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_{INTF}} = K_{SLOPE_1} \frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$$

where:

K_{SLOPE_1} - Variation of incremental side force slope with $\frac{d_{INTF}(x_{INTF}+200)}{d \cdot y_{INTF}}$, $\frac{ft^2}{deg}$, Figure 55.

d - Subject store diameter, ft.

d_{INTF} - Effective diameter of the interfering store, ft. Defined in Subsection 3.1.3.

x_{INTF} - Nose overlap distance, in. Defined in Subsection 3.1.3.

y_{INTF} - Lateral separation distance, in. Defined in Subsection 3.1.3.

Example: Calculate $\Delta\left(\frac{SF}{q}\right)_{\alpha_{INTF}}$ for a 300-gallon tank on the A-7 center pylon with an M117 on the inboard pylon and M = 0.5.

Required for Computation:

$d = 2.2$ ft

$d_{INTF} = 1.33$ ft

$x_{INTF} = 54.09$ in.

$y_{INTF} = 14.7$ in.

$K_{SLOPE_1} = -.0075$, Figure 55.

Substituting,

$$\Delta\left(\frac{SF}{q}\right)_{\alpha_{INTF}} = -.0075 \, \frac{1.33(54.09 + 200)}{2.2(14.7)}$$

$$= -.078 \, \frac{ft^2}{deg}$$

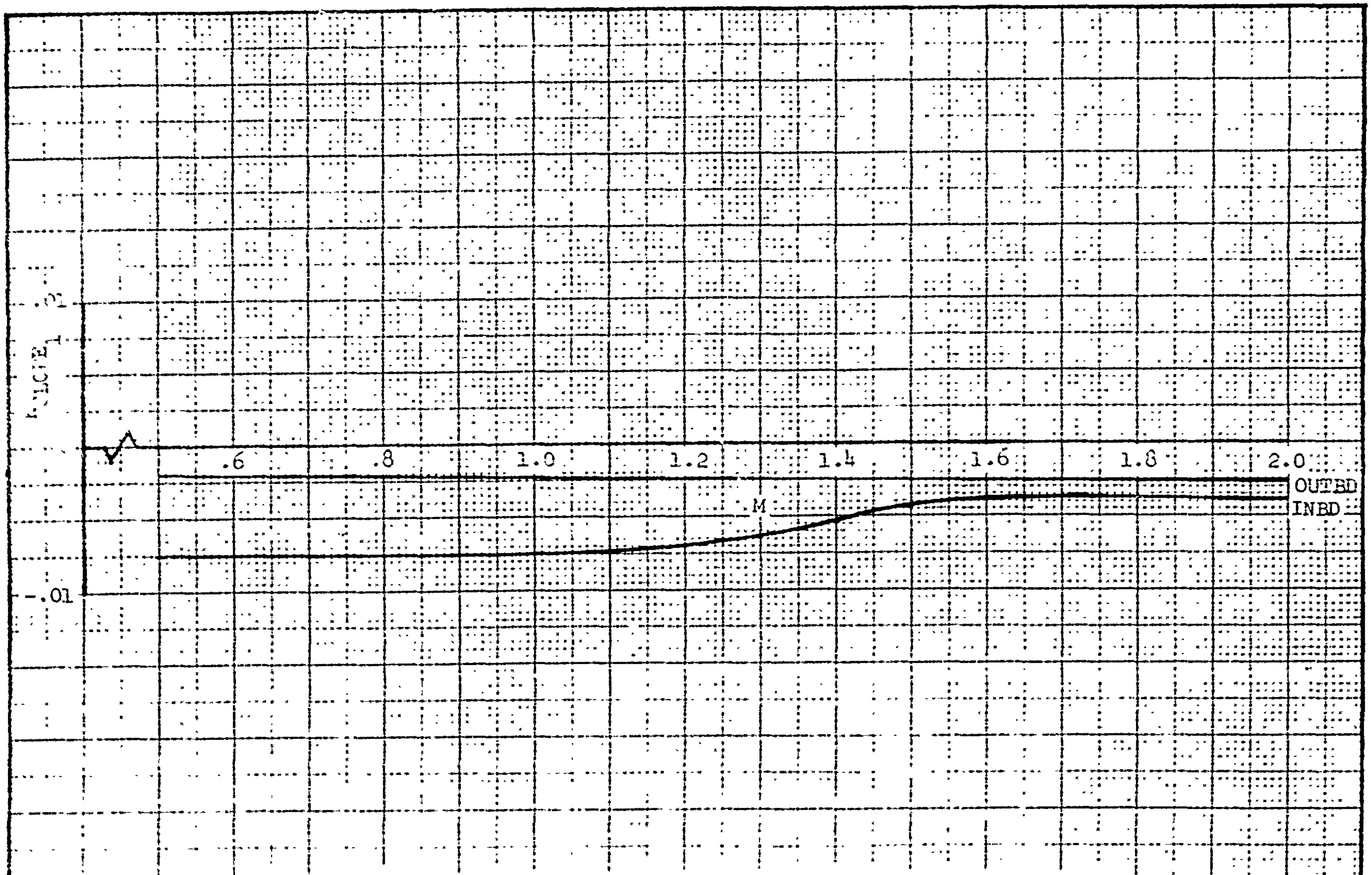

Figure 35. Incremental Side Force Slope Due to Interference - K_{SLOPE_1} for Inboard and Outboard Interference

3.1.3.2 Intercept Prediction

The equation to predict incremental side force intercept, $\Delta\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\INTF}}$, is given below.

$$\Delta\left(\frac{SF}{q}\right)_{\substack{\alpha=0\\INTF}} = K_{SLOPE_1}\left(\frac{d_{INTF}x_{INTF}}{d\cdot y_{INTF}}\right) + K_{INTC_1}$$

where:

K_{SLOPE_1} - Variation of incremental side force intercept with $\frac{d_{INTF}x_{INTF}}{d\cdot y_{INTF}}$, ft^2, Figure 56.

d_{INTF} - Effective diameter of the interfering store, ft, defined in Subsection 3.1.3.

d - Subject store diameter, ft.

x_{INTF} - Nose overlap distance, in., defined in Subsection 3.1.3.

y_{INTF} - Store seperation distance, in., defined in Subsection 3.1.3.

$$K_{INTC_1} = K_{SLOPE_2}\left(\frac{L}{C_{LOCAL}}\right) + K_{INTC_2}$$

where:

K_{SLOPE_2} - Variation of K_{INTC_1} with $\frac{L}{C_{LOCAL}}$, ft^2, Figure 57.

L - Subject store length, in.

C_{LOCAL} - Local wing chord length at subject store location, in.

K_{INTC_2} - Value of K_{INTC_1} when $\frac{L}{C_{LOCAL}} = 0$, ft^2, Figure 58.

Example: Calculate $\Delta\left(\frac{SF}{q}\right)_{\alpha=0_{INTF}}$ for a 300-gallon tank on A-7 center pylon with an M117 on inboard pylon and M = 0.5.

Required for Computation:

$d = 2.2$ ft

$d_{INTF} = 1.33$ ft

$x_{INTF} = 54.09$ in.

$y_{INTF} = 14.7$ in.

$L = 226$ in.

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_1} = .811$

$K_{SLOPE_1} = .168$ - Figure 56

$K_{SLOPE_2} = -.200$ - Figure 57

$K_{INTC_2} = -.350$ - Figure 58

Substituting,

$$K_{INTC_1} = -.200\left(\frac{226}{127.6}\right) + (-.350)$$
$$= -.704$$

$$\Delta\left(\frac{SF}{q}\right)_{\alpha=0_{INTF}} = .168\,\frac{1.33(54.09)}{2.2(14.7)} - .704$$
$$.330 \text{ ft}^2$$

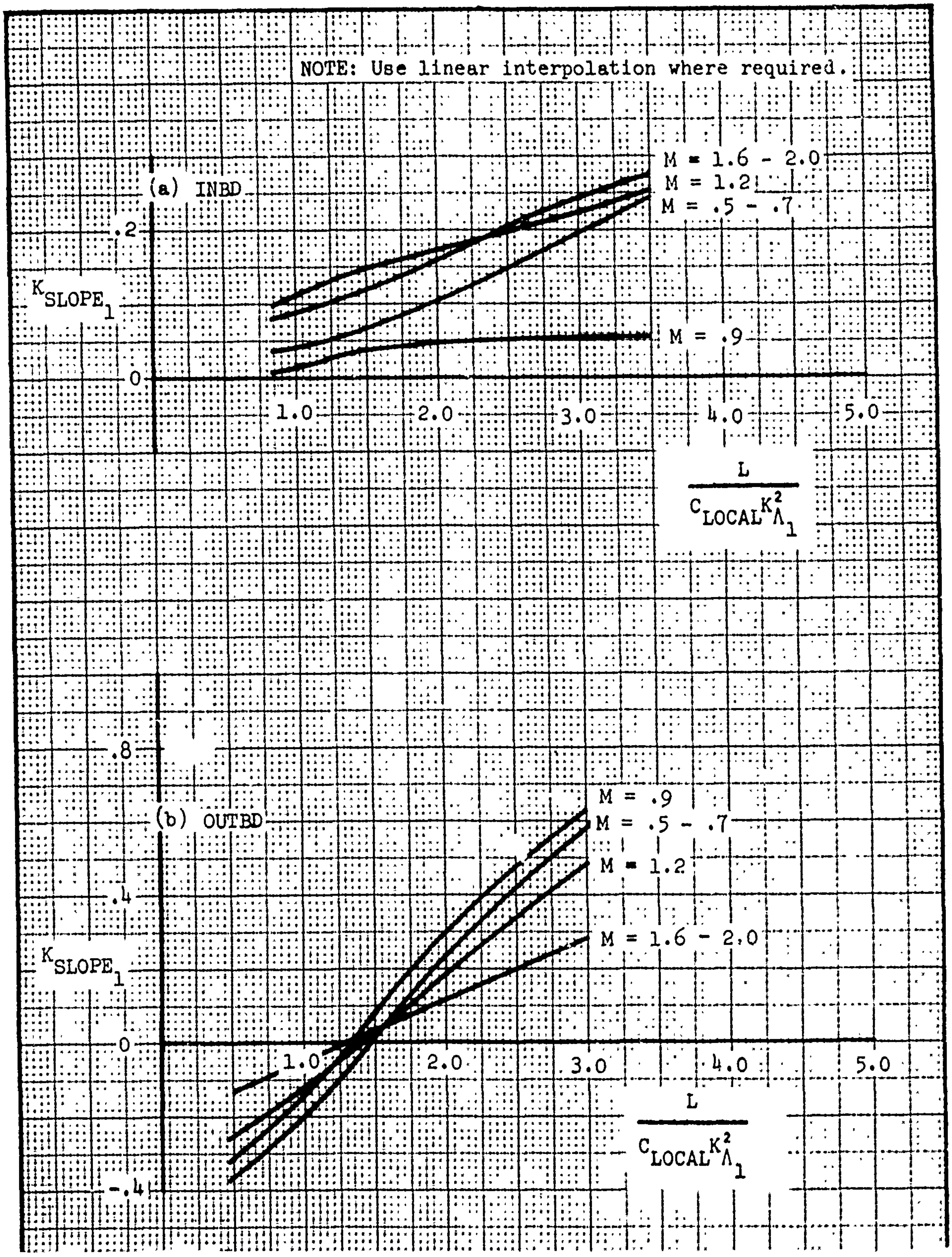

Figure 56. Incremental Side Force Intercept Due to Interference - K_{SLOPE_1} for Inboard and Outboard Interference

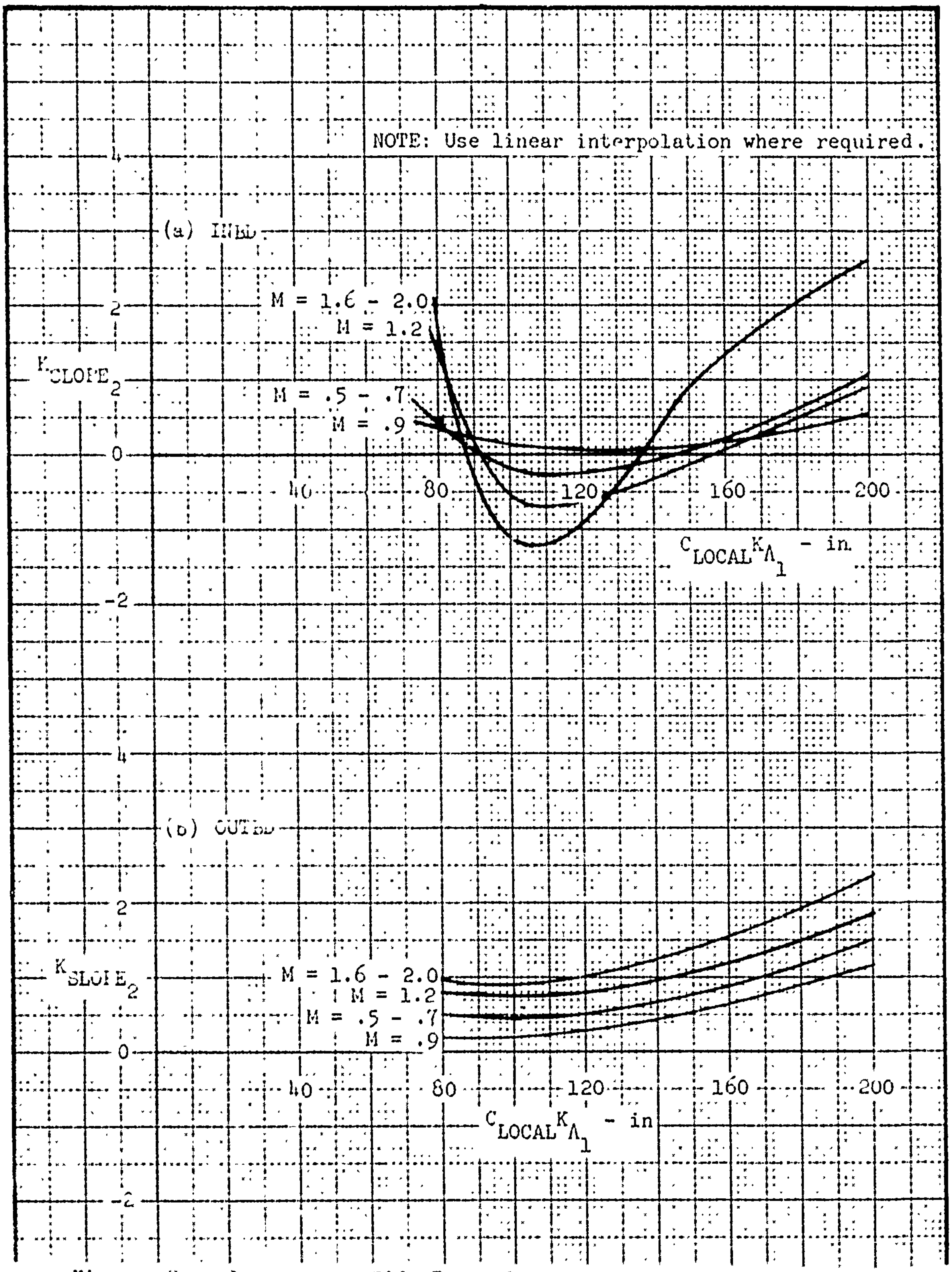

Figure 57. Incremental Side Force Intercept Due to Interference - K_{SLOPE_2} for Inboard and Outboard Interference

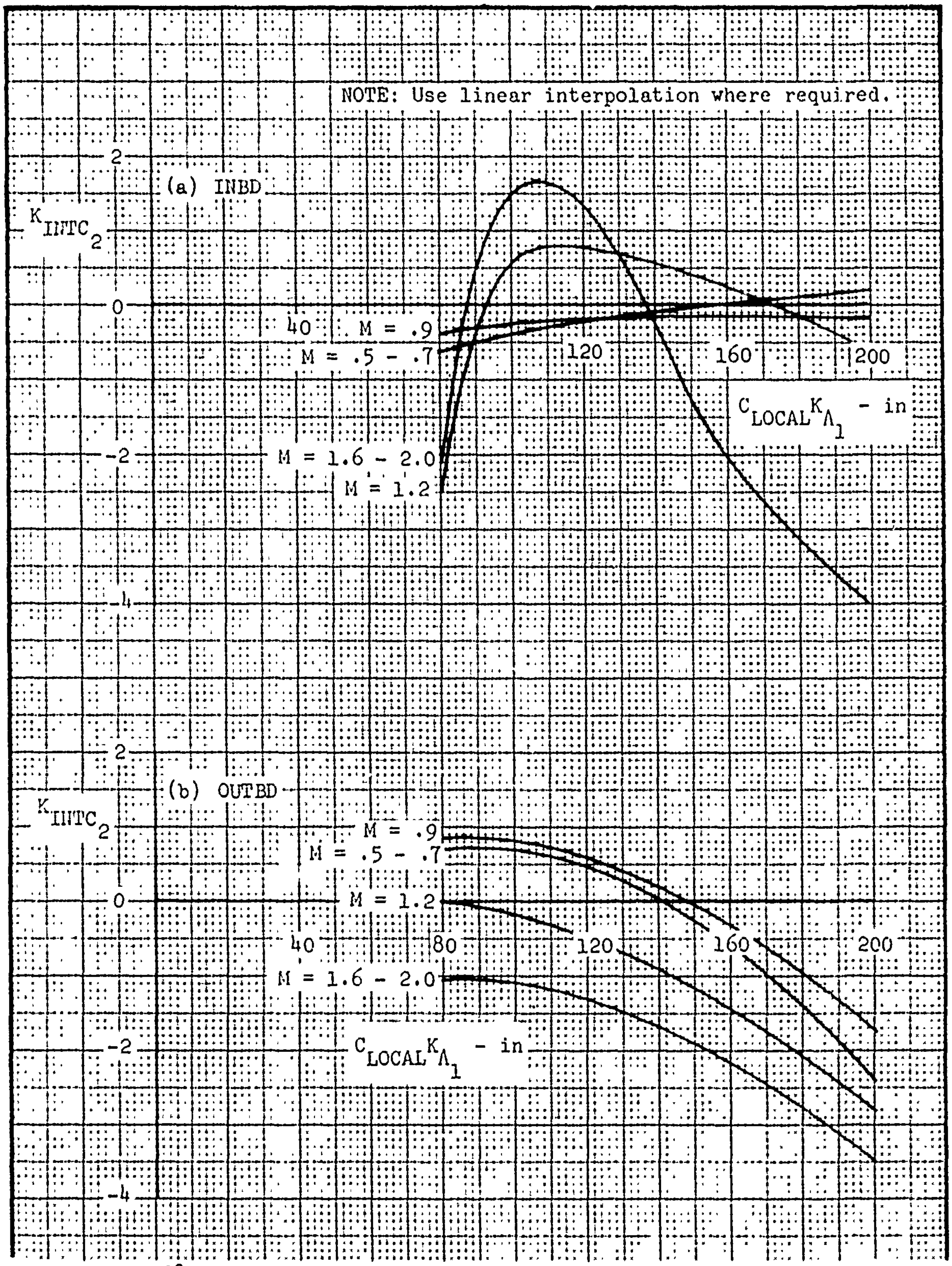

Figure 58. Incremental Side Force Intercept Due to Interference - K_{INTC_2} for Inboard and Outboard Interference

3.2 YAWING MOMENT

Captive store yawing moment is referenced on the store longitudinal axis at the store mid-lug (M.L.) point.

3.2.1 Basic Airload

3.2.1.1 Slope Prediction

The variation of yawing moment with angle of attack, $\left(\frac{YM}{q}\right)_\alpha$, at M = 0.5 can be predicted using the following relationship.

$$\left(\frac{YM}{q}\right)_{\alpha_{PRED}} = K_{C_{YM}}\left(\frac{SF}{q}\right)_{\psi_{ISO}} K_{\Lambda_1} + [K_{SLOPE_1}(C_{LOCAL}K_{\Lambda_1}) + K_{INTC_1} + \Delta K_{INTC_{INTF}}]K_{\Lambda_1} S_{REF} d$$

where:

$K_{C_{YM}}\left(\frac{SF}{q}\right)_{\psi_{ISO}}$ - Initial yawing moment slope prediction, $\frac{ft^3}{deg}$. See Subsection 2.3.3.

K_{SLOPE_1} - Variation of C_{n_α} with $C_{LOCAL}K_{\Lambda_1}$, $\frac{1}{in.deg.}$, $K_{SLOPE_1} = -.0016$ (constant).

C_{LOCAL} - Aircraft local wing chord, in.

K_{Λ_1} - Aircraft wing sweep correction factor, $\frac{\sin\Lambda}{\sin 45^\circ}$.

K_{INTC_1} - Value of C_{n_α} when $C_{LOCAL}K_{\Lambda_1} = 0$, $\frac{1}{deg}$, Figure 59.

$$K_{INTC_1} = f\left[\left(\frac{FIN\ SPA}{S_{REF}}\right)\left(\frac{L_n}{d}\right)\left(\frac{NOSE\ SPA}{SPA}\right)\right]$$

where:

FIN SPA - Store fin side projected area, in^2, Subsection 2.2.2.

$\frac{L_n}{d}$ - Store nose fineness ratio.

NOSE SPA - Store nose side projected area, in^2, Subsection 2.2.2.

SPA - Total side projected area of the store, in^2, Subsection 2.2.2.

$\Delta K_{INTC_{INTF}}$ - Increment in K_{INTC_1} due to the interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 60.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

d - Store diameter (reference length), ft

Example: Calculate the variation of yawing moment with angle of attack for a 300-gallon tank on the A-7 center pylon at M = 0.5.

Required for Computation:

FIN SPA = 447 in^2

S_{REF} = 3.83 ft^2

d = 2.208 ft

$\frac{L_n}{d} = 3.74$

NOSE SPA = 1630 in^2

SPA = 5007 in^2

η' = .270

C_{LOCAL} = 127.6 in.

$K_{\Lambda_1} = \frac{\sin 35°}{\sin 45°} = .811$

$$K_{C_{YM}}\left(\frac{SF}{q}\right)_{\psi_{ISO}} = (.889)(.262) = .233\ \frac{ft^3}{deg}$$

$$\left(\frac{FIN\ \ SPA}{S_{REF}}\right)\left(\frac{L_n}{d}\right)\left(\frac{NOSE\ \ SPA}{SPA}\right) = \left(\frac{447}{383}\right)(3.74)\ \left(\frac{1630}{5007}\right) = 142\ \frac{in^2}{ft^2}$$

K_{INTC_1} = .275, Figure 59

$\Delta K_{INTC_{INTF}}$ = 0, Figure 60

Substituting:

$$\left(\frac{YM}{q}\right)_{\alpha_{PRED}} = (.233)(.811) + [-.0016(127.6)(.811) + .275 + 0] \cdot (.811)(3.83)(2.208) = .939\frac{ft^3}{deg}$$

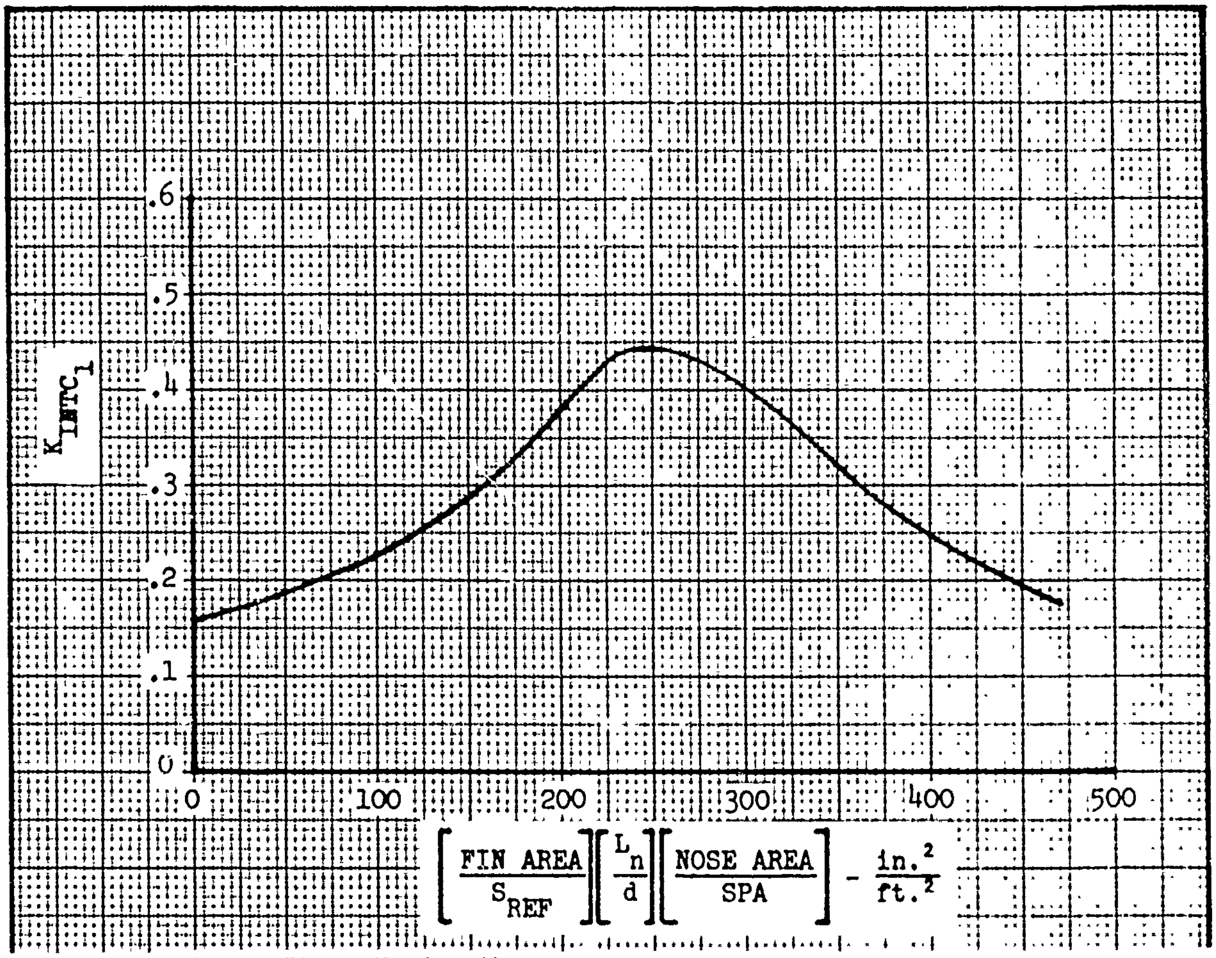

Figure 59. Yawing Moment Slope - Value at $C_{LOCAL}\ K_{\Lambda_1} = 0$

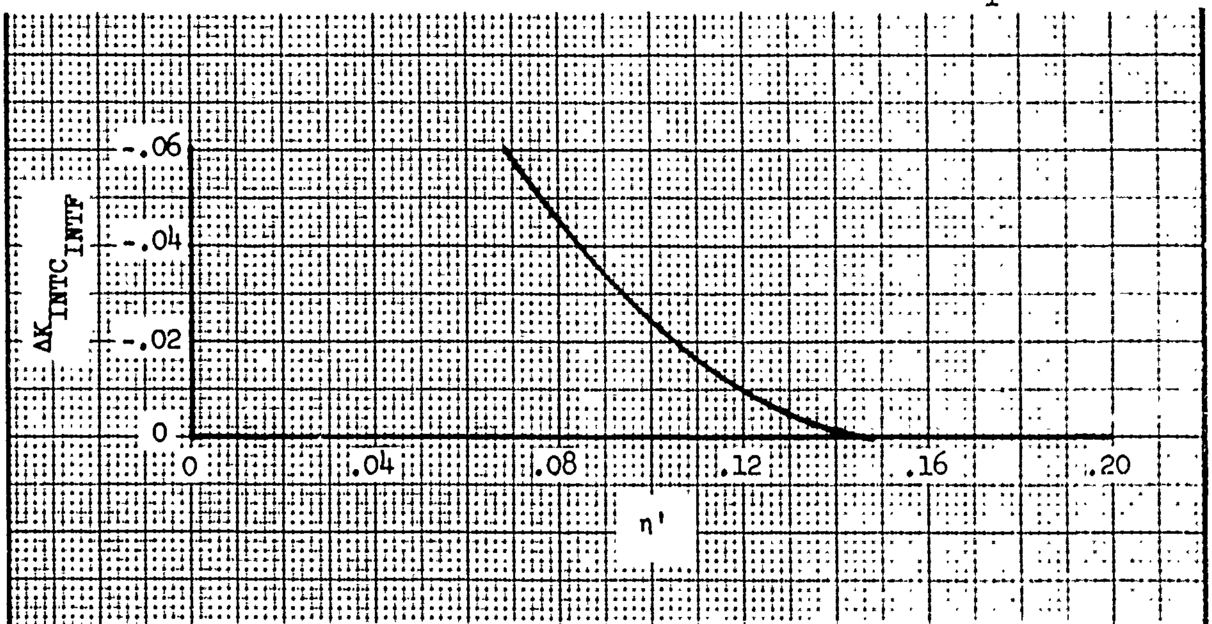

Figure 60. **Yawing** Moment Slope - K_{INTC} Fuselage Interference Correction

3.2.1.2 Slope Mach Number Correction

To compute the variation in yawing moment slope, $\left(\frac{YM}{q}\right)_\alpha$, between M = 0.5 and M = 2.0, use the following expression.

$$\left(\frac{YM}{q}\right)_{\alpha_{M=x}} = \left(\frac{YM}{q}\right)_{\alpha_{PRED}} + \Delta\left(\frac{YM}{q}\right)_{\alpha_{M=x}}$$

where:

$\left(\frac{YM}{q}\right)_{\alpha_{PRED}}$ - Yawing moment slope predicted at M = 0.5

$\Delta\left(\frac{YM}{q}\right)_{\alpha_{M=x}}$ - Increment in yawing moment slope at M=x.

The procedure for calculating the Mach number correction for yawing moment slope is the same as that presented in Subsection 3.1.1.2 for the side force slope Mach number correction.

The yawing moment slope variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, M_2, and M_4 as in Figure 61.

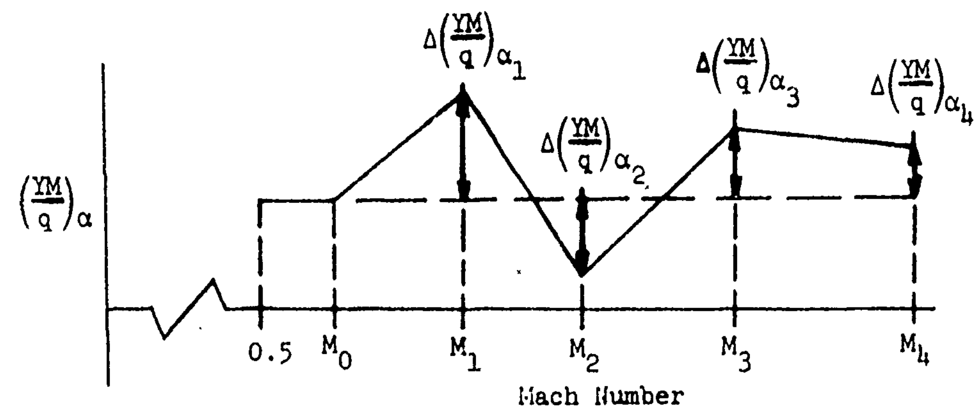

Figure 61. Yawing Moment Slope - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figure 62 as a function of $C_{LOCAL}K_{\Lambda_1}$. M_0 is the Mach number where

the slope initially deviates from the slope predicted at M = 0.5. Equations have been developed to predict the delta (incremental) slope change from that predicted at M = 0.5 at each of the remaining Mach break points (M_1, M_2, M_3, M_4). These equations are presented below.

Break 1 (M_1):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_1} = [K_{SLOPE_1}\left(\frac{K_{C_{YM}}\,SPA}{\ell_{LE}S_{REF}}\right) + K_{INTC_1}]K_{\Lambda_1}S_{REF}$$

where:

K_{SLOPE_1} - Variation of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_1}$ with $\frac{K_{C_{YM}}\,SPA}{\ell_{LE}S_{REF}}$, $\frac{ft^2}{in.deg.}$, Figure 63.

$K_{C_{YM}}$ - Yawing moment correlation parameter, Subsection 2.3.3.

SPA - Store side projected area, in^2, Subsection 2.2.2.

ℓ_{LE} - Distance that the store nose extends forward of the aircraft wing leading edge as measured in the wing plan view, in.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

K_{INTC_1} - Value of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_1}$ when $\frac{K_{C_{YM}}\,SPA}{\ell_{LE}S_{REF}} = 0$, $\frac{ft}{deg}$, Figure 64.

K_{Λ_1} - Aircraft wing sweep correction factor, $\frac{\sin \Lambda}{\sin 45^o}$, where Λ is the wing quarter-chord sweep angle.

Break 2 (M_2):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_2} = [K_{SLOPE_2}\left(\frac{K_{C_{YM}}\,SPA}{\ell_{LE}S_{REF}}\right) + K_{INTC_2}]K_{\Lambda_1}S_{REF}$$

where:

K_{SLOPE_2} - Variation of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_2}$ with $\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}}$, $\frac{ft^2}{in.deg.}$, Figure 65.

K_{INTC_2} - Value of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_2}$ when $\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}} = 0$, $\frac{ft}{deg}$, Figure 66.

Break 3 (M_3):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_3} = [K_{SLOPE_3}\left(\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}}\right) + K_{INTC_3}]K_{\Lambda_1} S_{REF}$$

where:

K_{SLOPE_3} - Variation of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_3}$ with $\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}}$, $\frac{ft^2}{in.deg.}$, Figure 67.

K_{INTC_3} - Value of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_3}$ when $\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}} = 0$, $\frac{ft}{deg}$, Figure 68.

Break 4 (M_4):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_4} = [K_{SLOPE_4}\left(\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}}\right) + K_{INTC_4}]K_{\Lambda_1} S_{REF}$$

where:

K_{SLOPE_4} - Variation of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_4}$ with $\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}}$, $\frac{ft^2}{in.deg.}$, Figure 69.

K_{INTC_4} - Value of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha_4}$ when $\frac{K_{C_{YM}}\ SPA}{\ell_{LE} S_{REF}} = 0$, $\frac{ft}{deg}$, Figure 70.

To compute $\left(\frac{YM}{q}\right)_{\alpha}$ at $M = x$, first determine from Figure 62 between which Mach number break points $M = x$ occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\left(\frac{YM}{q}\right)_{\alpha}$ at $M = x$ from the expression below.

$$\left(\frac{YM}{q}\right)_{\alpha_{M=x}} = \left(\frac{YM}{q}\right)_{\alpha_{\substack{PRED\\M=0.5}}} + \Delta\left(\frac{YM}{q}\right)_{\alpha_{LOW}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)\left[\Delta\left(\frac{YM}{q}\right)_{\alpha_{HI}} - \Delta\left(\frac{YM}{q}\right)_{\alpha_{LOW}}\right]$$

A numerical example is included in Subsection 3.1.1.2 that illustrates the application of the above equation.

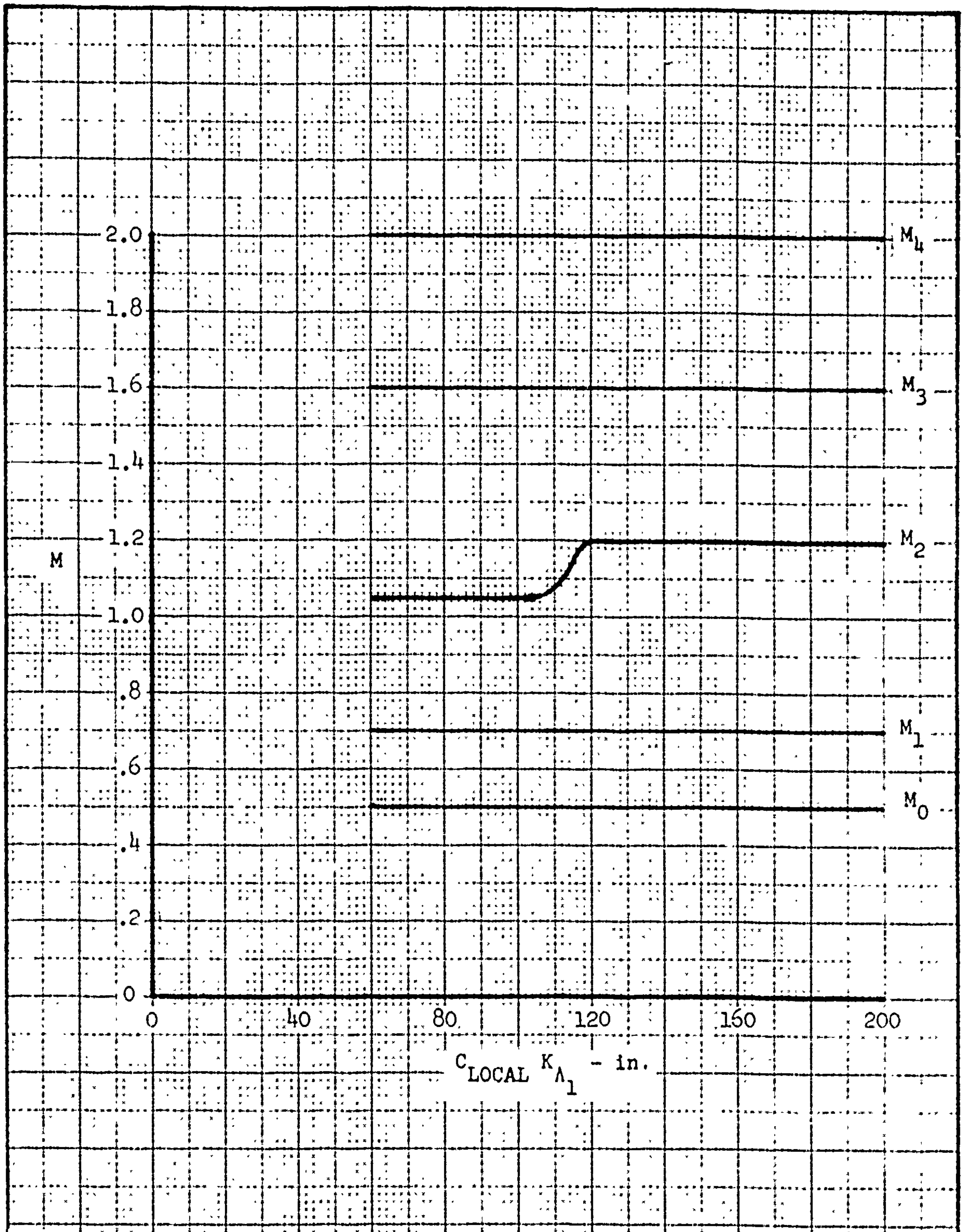

Figure 62. Yawing Moment Slope - Mach Number Break Points

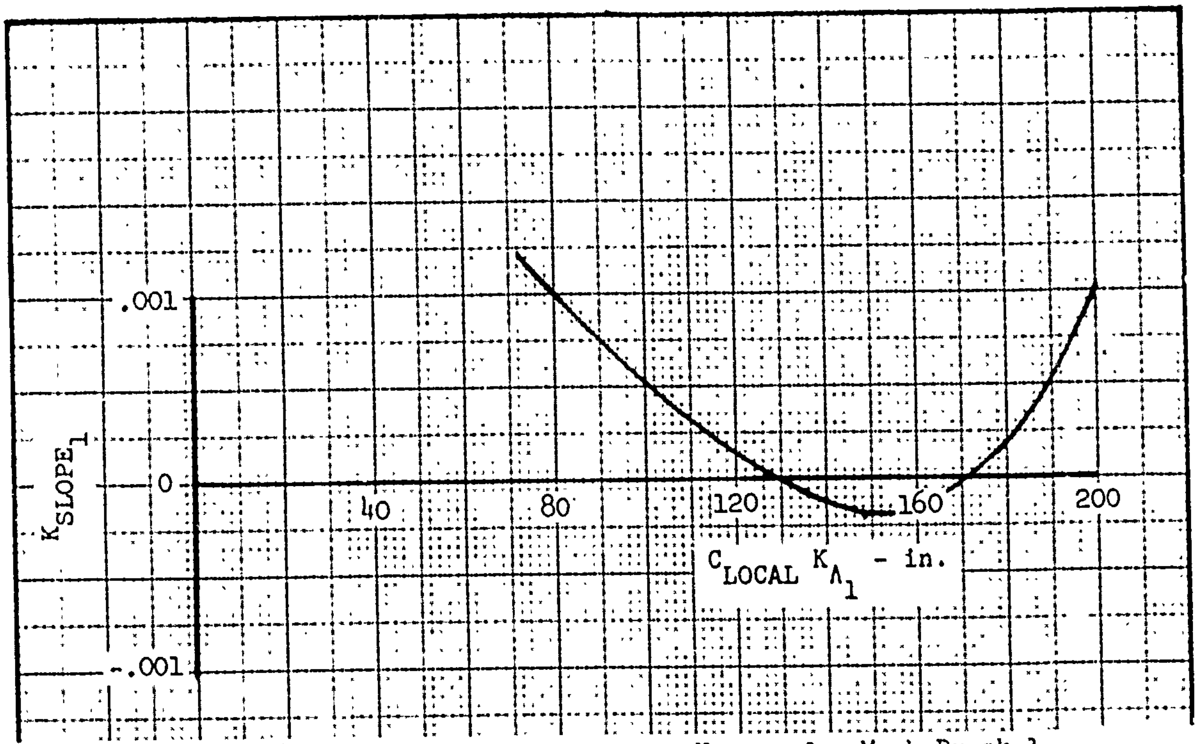

Figure 63. Yawing Moment Slope - K_{SLOPE} for Mach Break 1

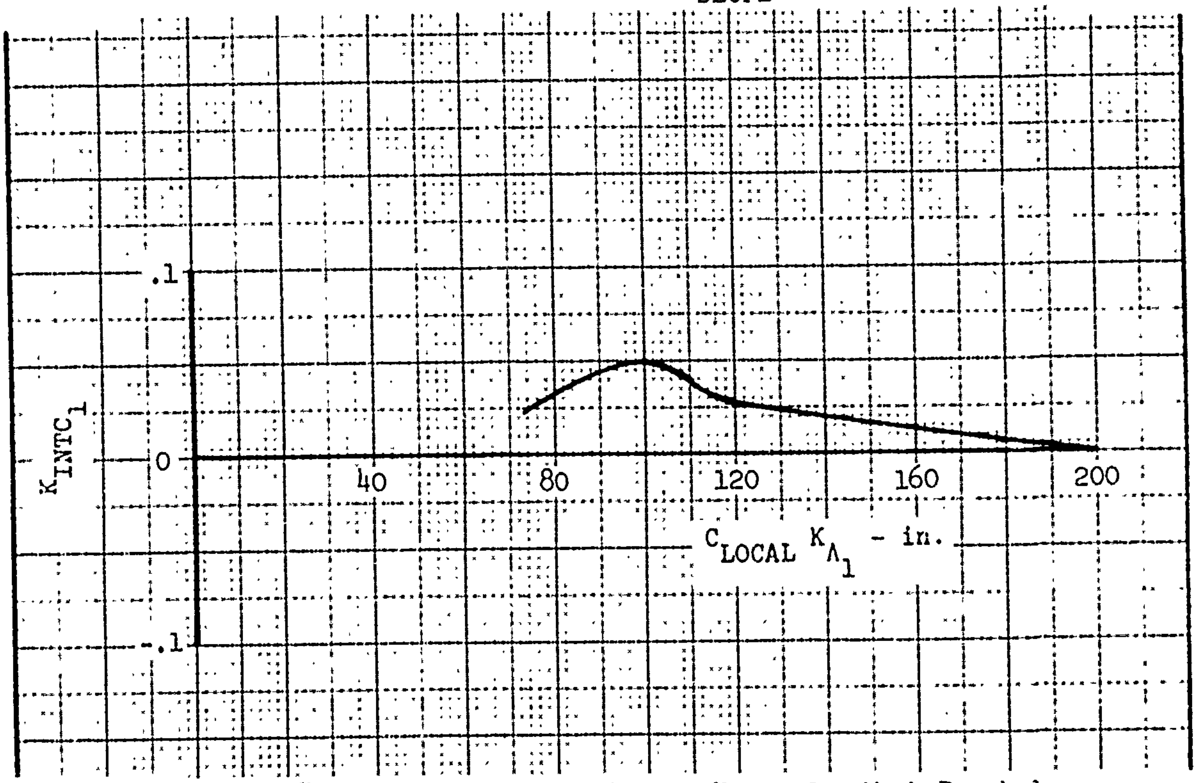

Figure 64. Yawing Moment Slope - K_{INTC} for Mach Break 1

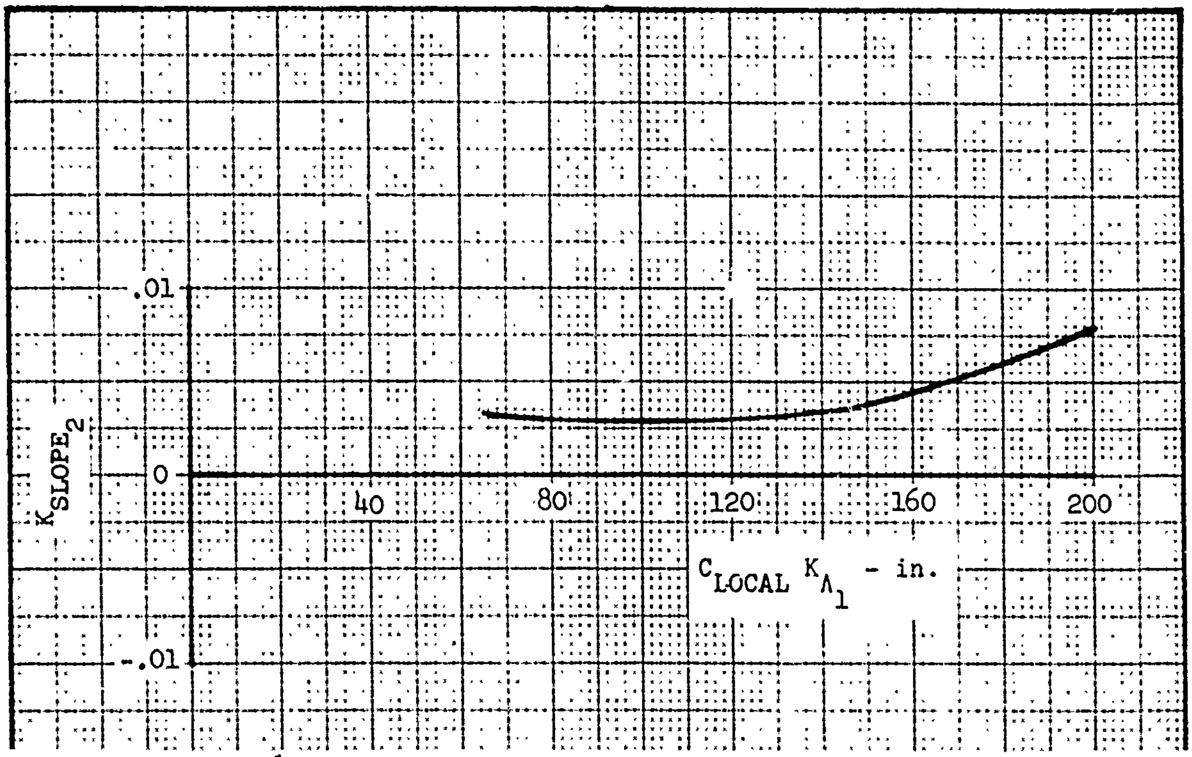

Figure 65. Yawing Moment Slope - K_{SLOPE} for Mach Break 2

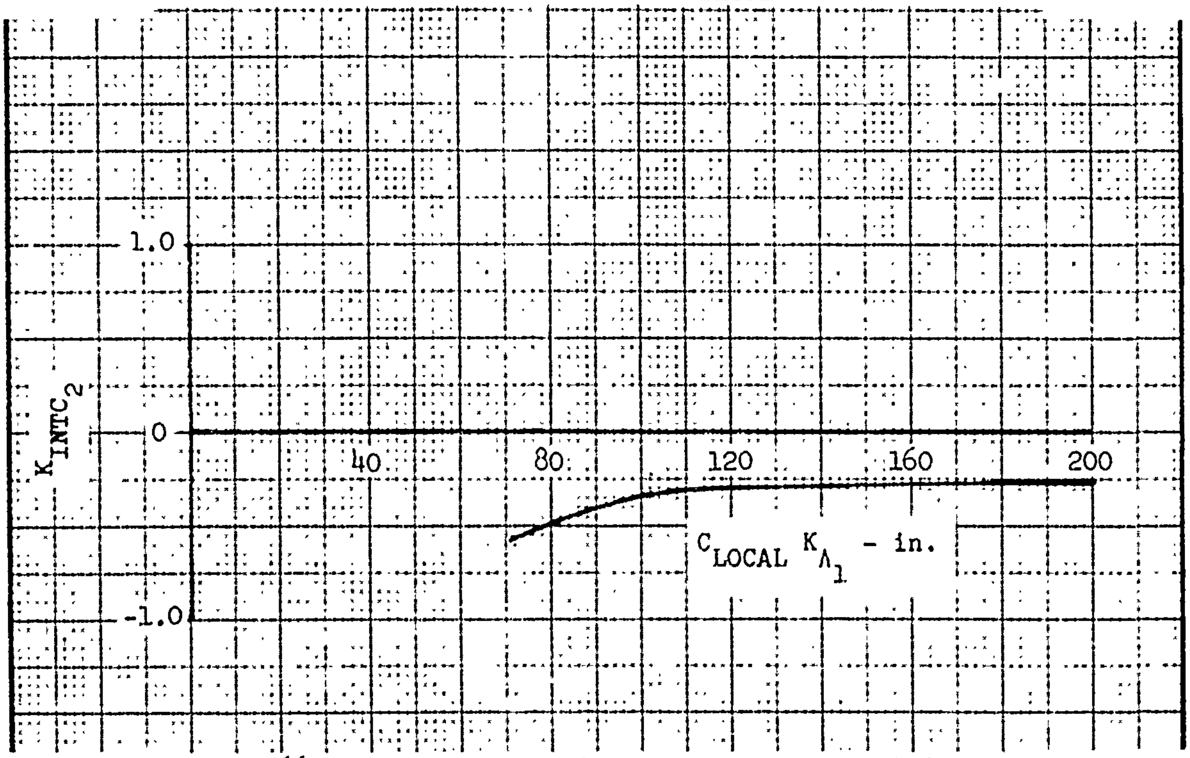

Figure 66. Yawing Moment Slope - K_{INTC} for Mach Break 2

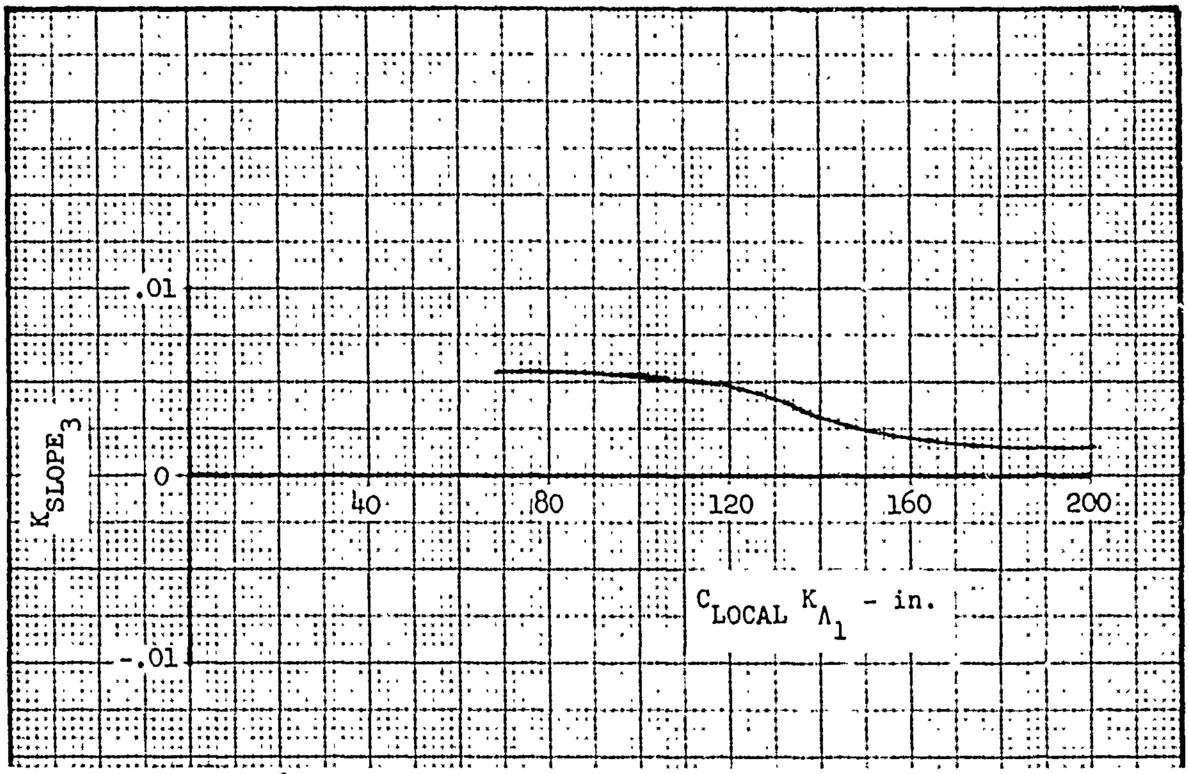

Figure 67. Yawing Moment Slope - K_{SLOPE} for Mach Break 3

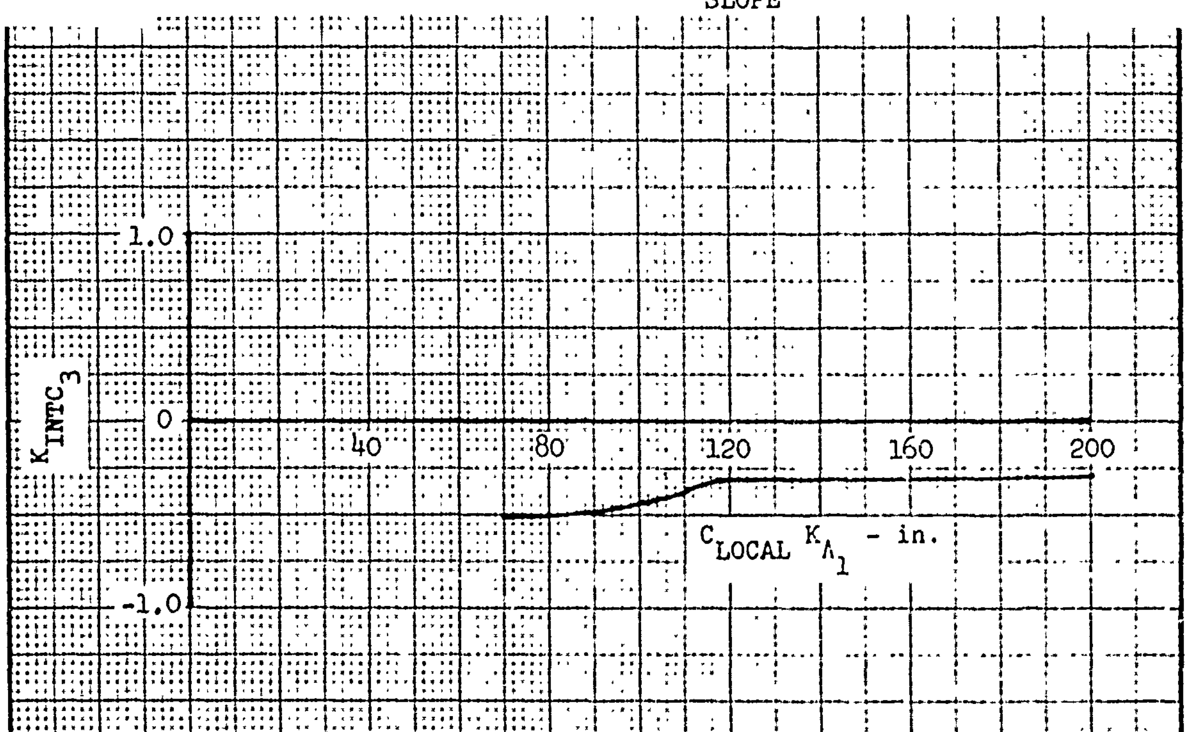

Figure 68 Yawing Moment Slope - K_{INTC} for Mach Break 3

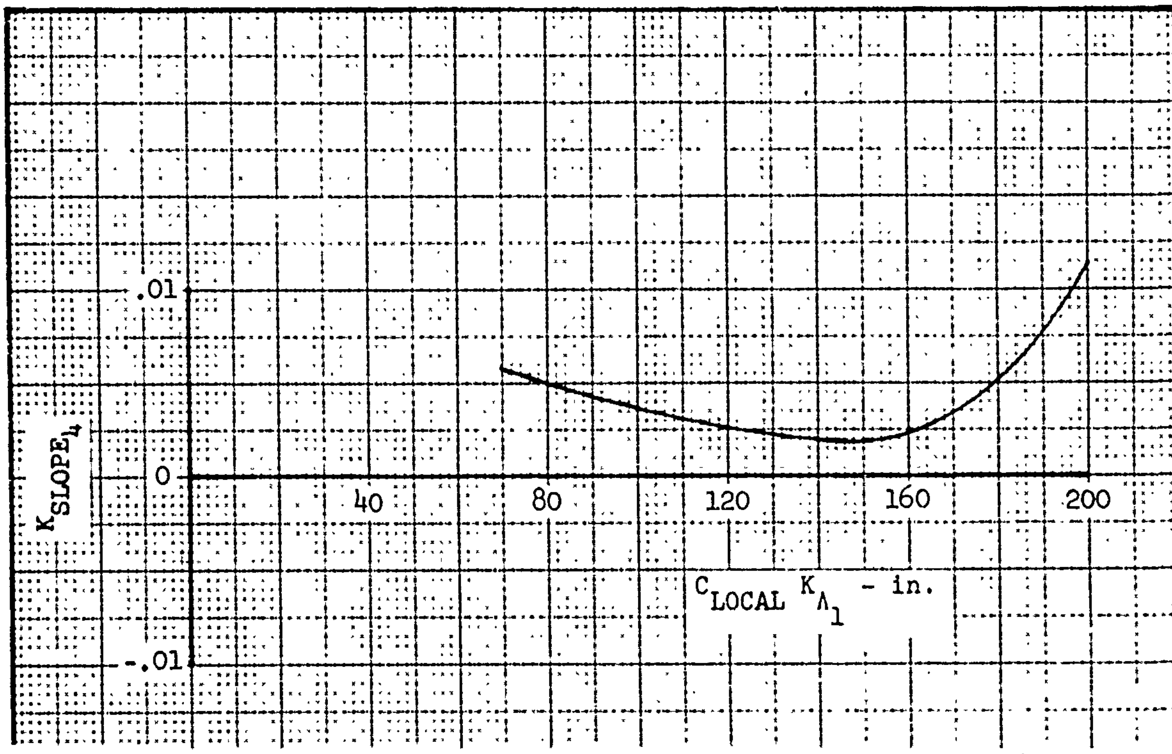

Figure 69. Yawing Moment Slope - K_{SLOPE} for Mach Break 4

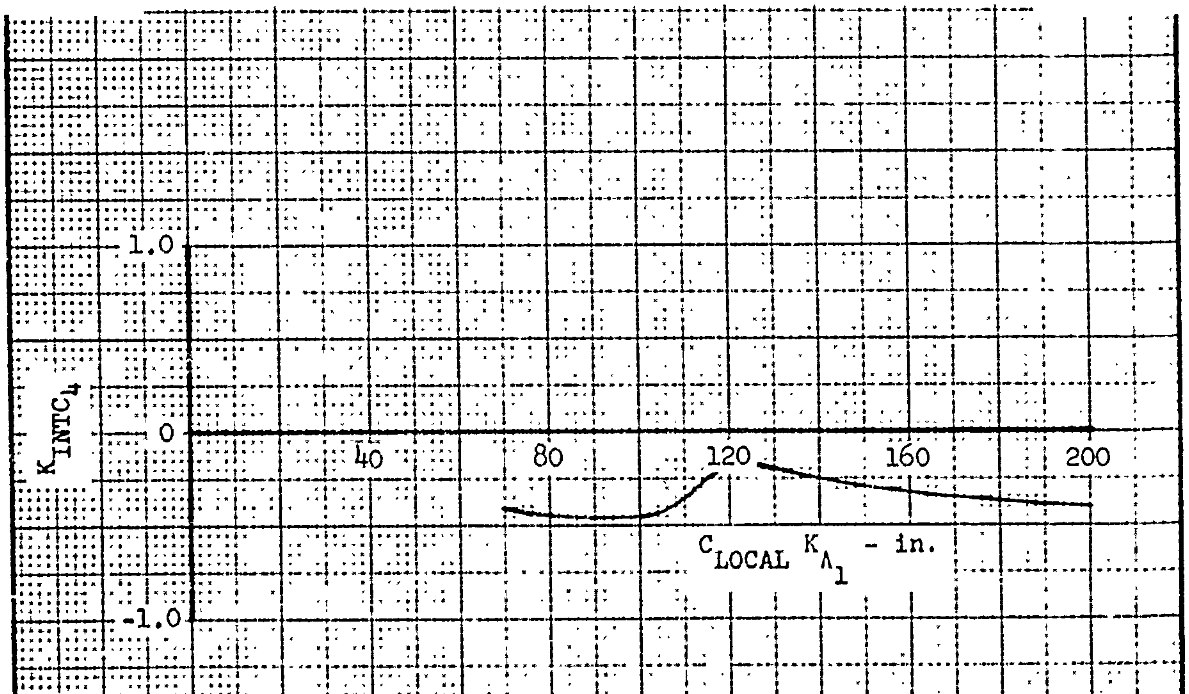

Figure 70. Yawing Moment Slope - K_{INTC} for Mach Break 4

3.2.1.3 Intercept Prediction

The value of yawing moment intercept, $\left(\frac{YM}{q}\right)_{\alpha=0}$, at M=0.5 is predicted from the following relationship.

$$\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\PRED}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})\,\ell_{LE} + K_{INTC_1} + \Delta K_{INTC_{INTF}}]K_{\Lambda_1}$$

where:

K_{SLOPE_1} - Variation of $\left(\frac{YM}{q}\right)_{\alpha=0}$ with ℓ_{LE}, $\frac{ft.^3}{in.}$, Figure 71.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to the interference effect of the fuselage for high-wing aircraft, $\frac{ft.^3}{in.}$, Figure 72.

ℓ_{LE} - Distance that the store nose extends forward of the aircraft wing leading edge as measured in the wing plan view, in.

K_{INTC_1} - Value of $\left(\frac{YM}{q}\right)_{\alpha=0}$ when ℓ_{LE}=0, ft ^{3}, Figure 73.

$K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to the interference effect of the fuselage for high-wing aircraft, ft ^{3}, Figure 74.

K_{Λ_1} - Aircraft wing sweep correction factor, $\frac{\sin \Lambda}{\sin 45°}$, where Λ is the wing quarter-chord sweep angle.

Example:

Compute the yawing moment intercept, $\left(\frac{YM}{q}\right)_{\alpha=0}$ for a 300-gallon tank on the A-7 center pylon at M=0.5.

Required for Computation:

C_{LOCAL} = 127.6 in.

$$K_{\Lambda_1} = \frac{\sin 35^\circ}{\sin 45^\circ} = .811$$

$$\eta' = .27$$

$$\ell_{LE} = 75.1 \text{ in.}$$

$K_{SLOPE_1} = -.011$ - Figure 71

$\Delta K_{SLOPE_{INTF}} = 0$ - Figure 72

$K_{INTC_1} = 1.1$ - Figure 73

$\Delta K_{INTC_{INTF}} = 0$ - Figure 74

substituting,

$$\left(\frac{YM}{q}\right)_{\alpha=0} = [(-.011+0)(75.1)+1.1+0](.811) = .22 \text{ ft}^3$$

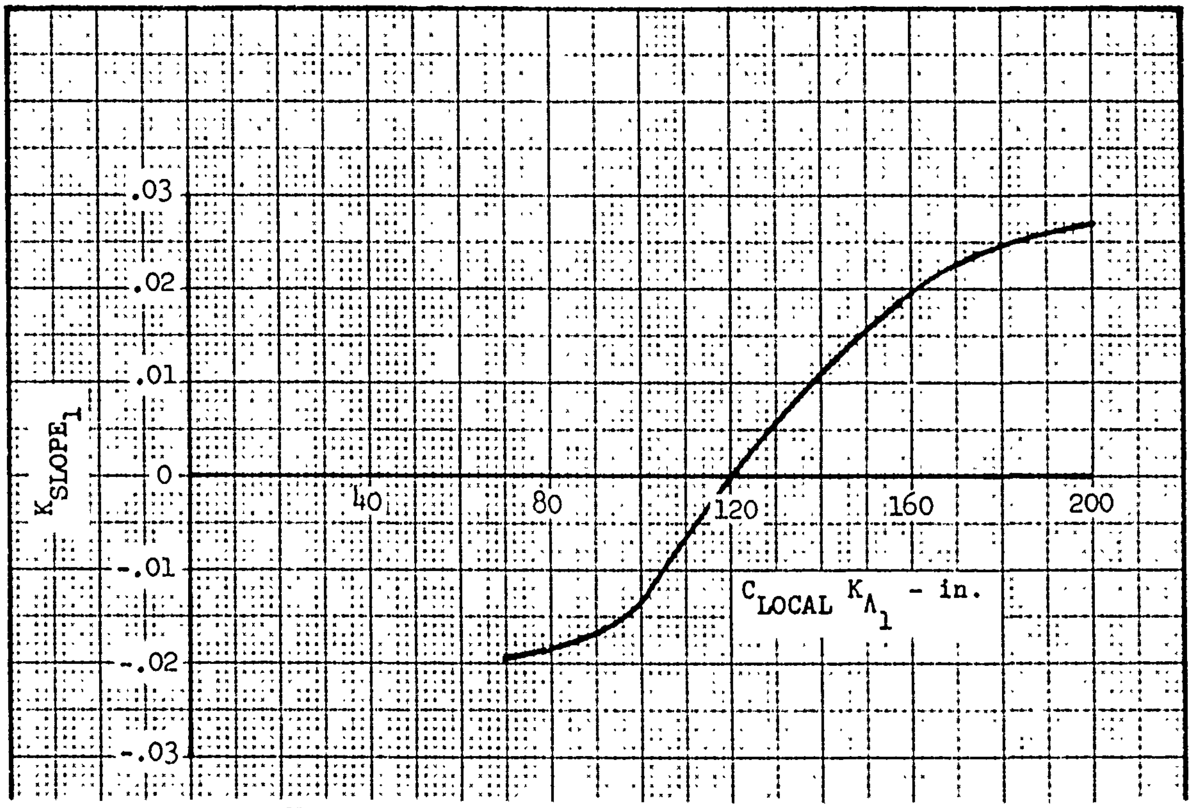

Figure 71. Yawing Moment Intercept - Variation with ℓ_{LE}

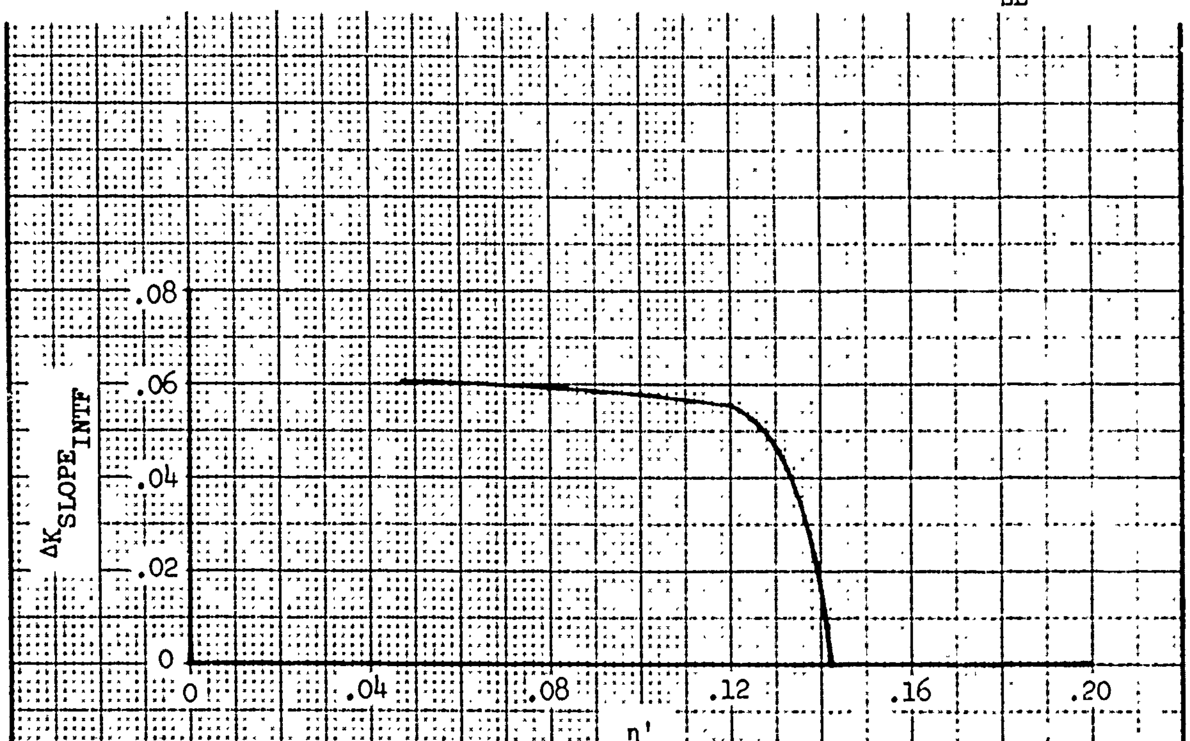

Figure 72. Yawing Moment Intercept - K_{SLOPE_1} Fuselage Interference Correction

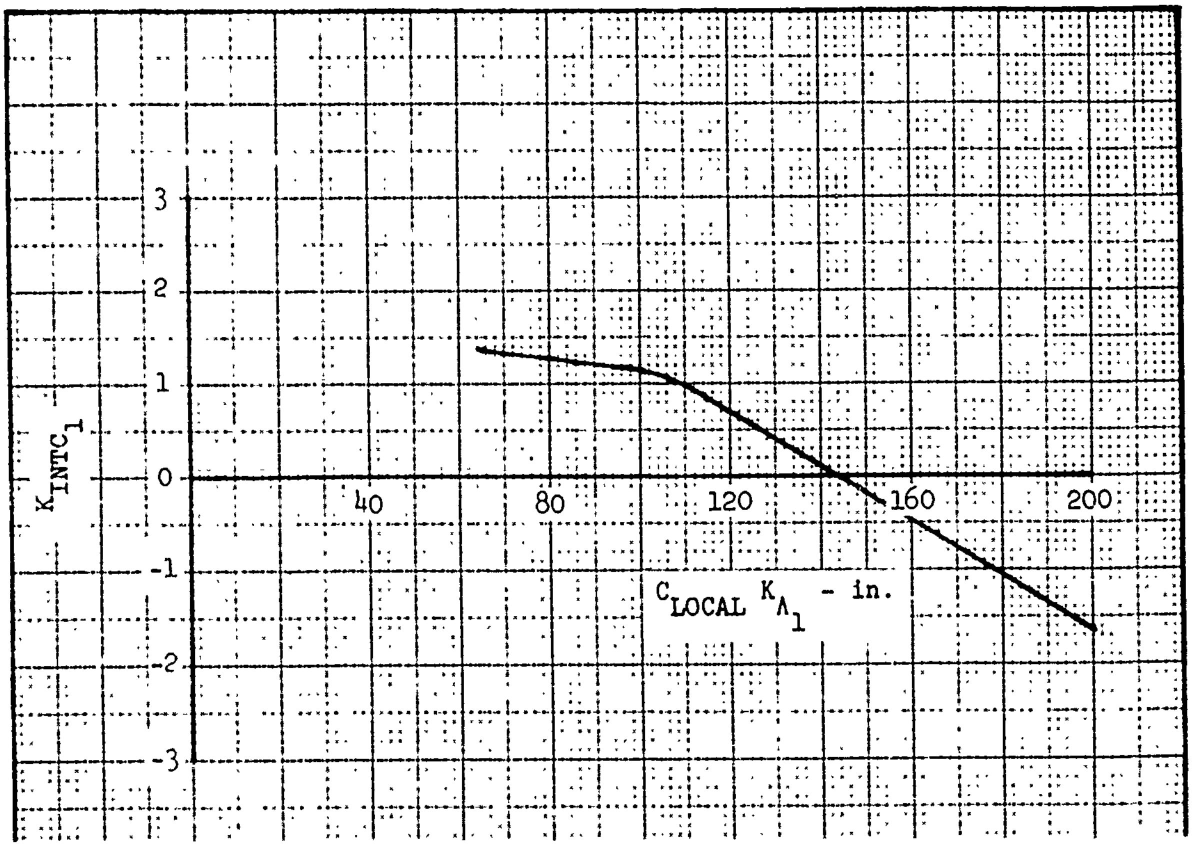

Figure 73. Yawing Moment Intercept - Value at $\ell_{LE} = 0$

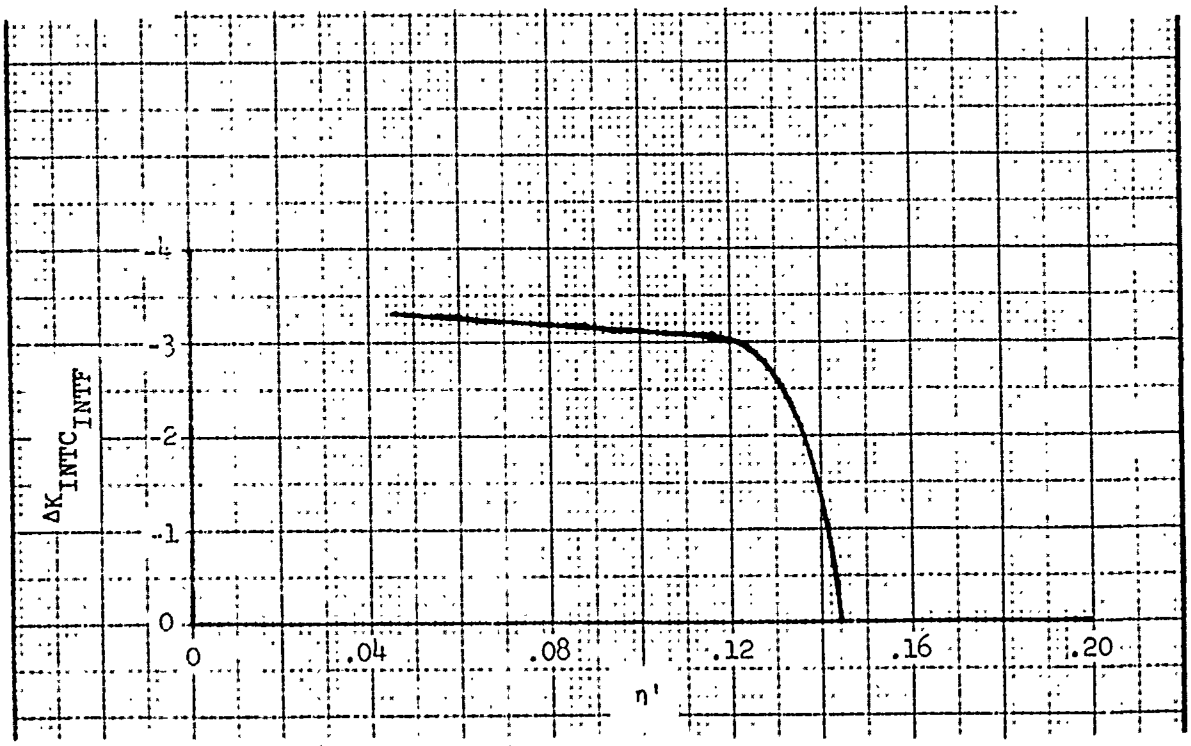

Figure 74. Yawing Moment Intercept - K_{INTC_1} Fuselage Interference Correction

3.2.1.4 Intercept Mach Number Correction

The procedure for calculating the Mach number correction for yawing moment intercept is the same as that presented in Subsection 3.1.1.2 for the side force slope Mach number correction.

The yawing moment intercept variation with Mach number has been approximated by a series of linear segments with break points occuring at Mach numbers defined by M_o, M_1, M_2, and M_3 as in Figure 75.

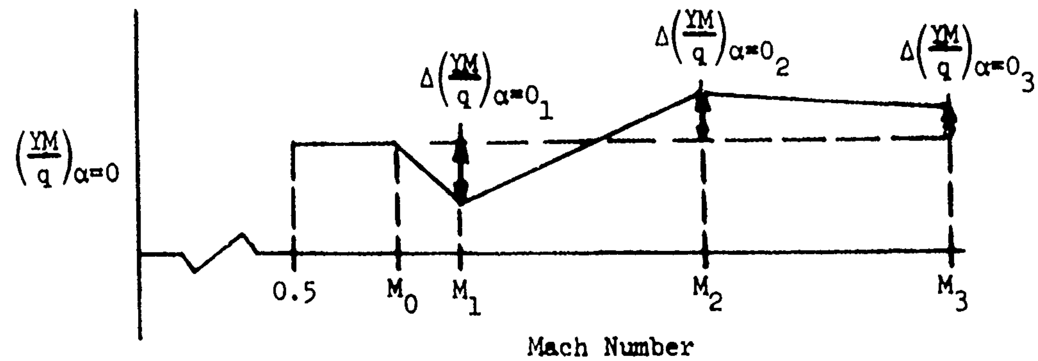

Figure 75. Yawing Moment Intercept - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figure 76 as a function of $C_{LOCAL}\ K_{\Lambda_1}$. M_o is the Mach number where the intercept initially deviates from the intercept predicted at M=0.5. Equations have been developed to predict the delta (incremental) intercept change from that predicted at M=0.5 at each of the remaining Mach break points (M_1, M_2, M_3). These equations are presented below.

Break 1 (M_1):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_1} = (K_{SLOPE_1}\ \ell_{LE} + K_{INTC_1})\ K_{\Lambda_1}\ S_{REF}$$

where:

K_{SLOPE_1} - Variation of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha=0_1}$ with ℓ_{LE}, $\frac{ft.}{in.}$, Figure 77.

ℓ_{LE} - Defined in Subsection 3.2.1.3.

K_{INTC_1} - Value of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha=0_1}$ when ℓ_{LE} = 0, ft , Figure 78.

K_{Λ_1} - Defined in Subsection 3.2.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

Break 2 (M_2):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_2} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF}})\ell_{LE} + K_{INTC_2} + \Delta K_{INTC_{INTF}}]K_{\Lambda_1} S_{REF}$$

where:

K_{SLOPE_2} - Variation of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha=0_2}$ with ℓ_{LE}, $\frac{ft.}{in.}$, Figure 79.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_2} due to the interference effect of the fuselage for high wing aircraft, $\frac{ft.}{in.}$, Figure 80.

ℓ_{LE} - Defined in Subsection 3.2.1.3.

K_{INTC_2} - Value of $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha=0_2}$ when $\ell_{LE} = 0$, ft , Figure 81.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_2} due to the interference effect of the fuselage for high wing aircraft, ft., Figure 82.

K_{Λ_1} - Defined in Subsection 3.2.1.3.

S_{REF} - Defined under Break 1.

Break 3 (M_3):

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_3} = (K_{SLOPE_3}\ell_{LE} + K_{INTC_3})K_{\Lambda_1}S_{REF}$$

where:

K_{SLOPE_3} - Variation in $\Delta\left(\frac{YM}{qS_{REF}}\right)_{\alpha=0_3}$ with ℓ_{LE}, $\frac{ft.}{in.}$, Figure 83.

ℓ_{LE} - Defined in Subsection 3.2.1.3.

K_{INTC_3} - Value of $\left(\frac{YM}{qS_{REF}}\right)_{\alpha=0_3}$ when ℓ_{LE} = 0, ft , Figure 84.

K_{Λ_1} - Defined in Subsection 3.2.1.3.

S_{REF} - Defined under Break 1.

To compute $\left(\frac{YM}{q}\right)_{\alpha=0}$ at M = x, first determine from Figure 76 between which Mach number break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\left(\frac{YM}{q}\right)_{\alpha=0}$ at M = x from the expression below.

$$\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{YM}{q}\right)_{\substack{\alpha=0\\PRED\\M=0.5}} + \Delta\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\LOW}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)\left[\Delta\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\HI}} - \Delta\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\LOW}}\right]$$

A numerical example is included in Subsection 3.1.1.2 that illustrates the application of the above equation.

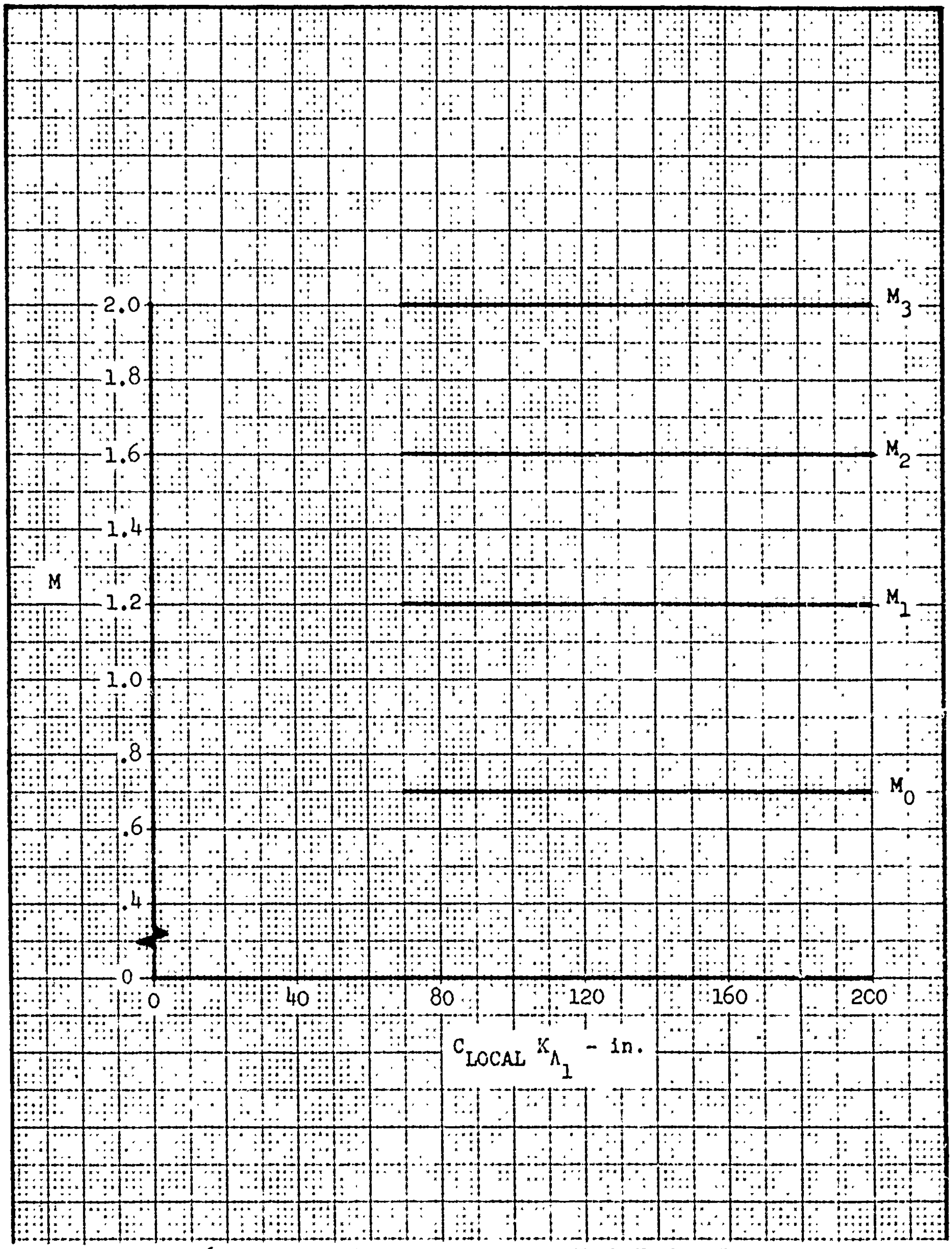

Figure 76. Yawing Moment Intercept - Mach Number Break Points

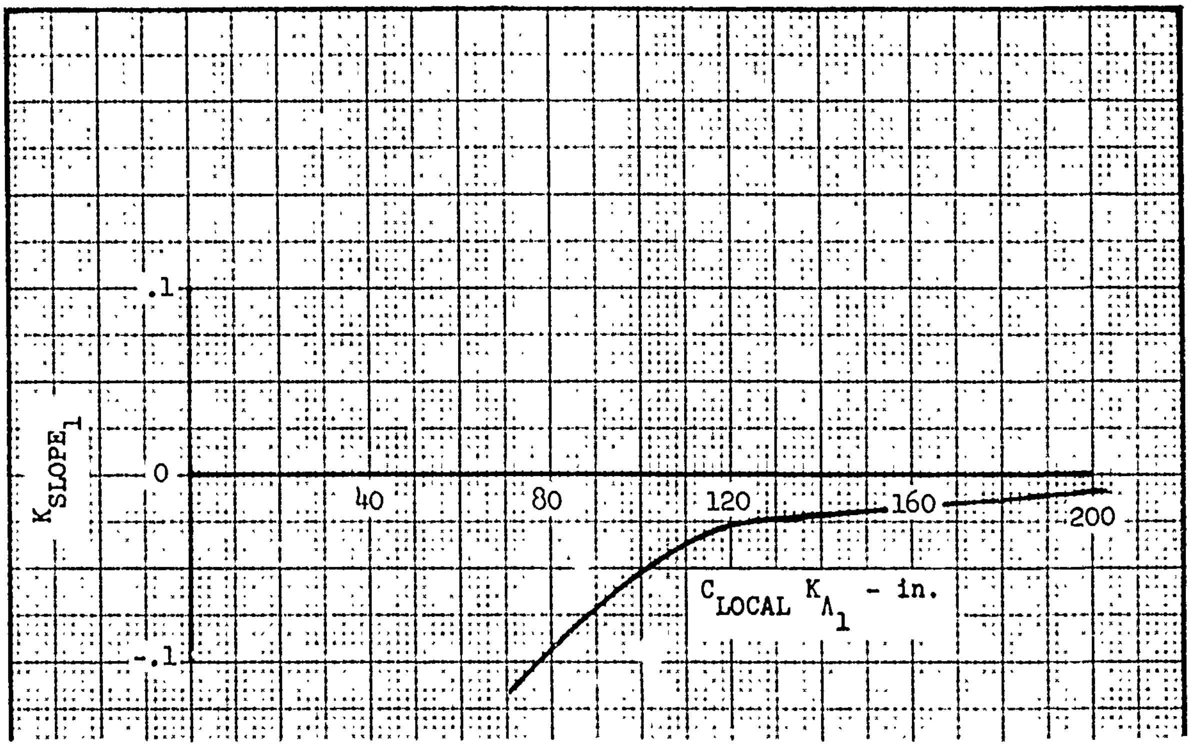

Figure 77. Yawing Moment Intercept - K_{SLOPE} for Mach Break 1

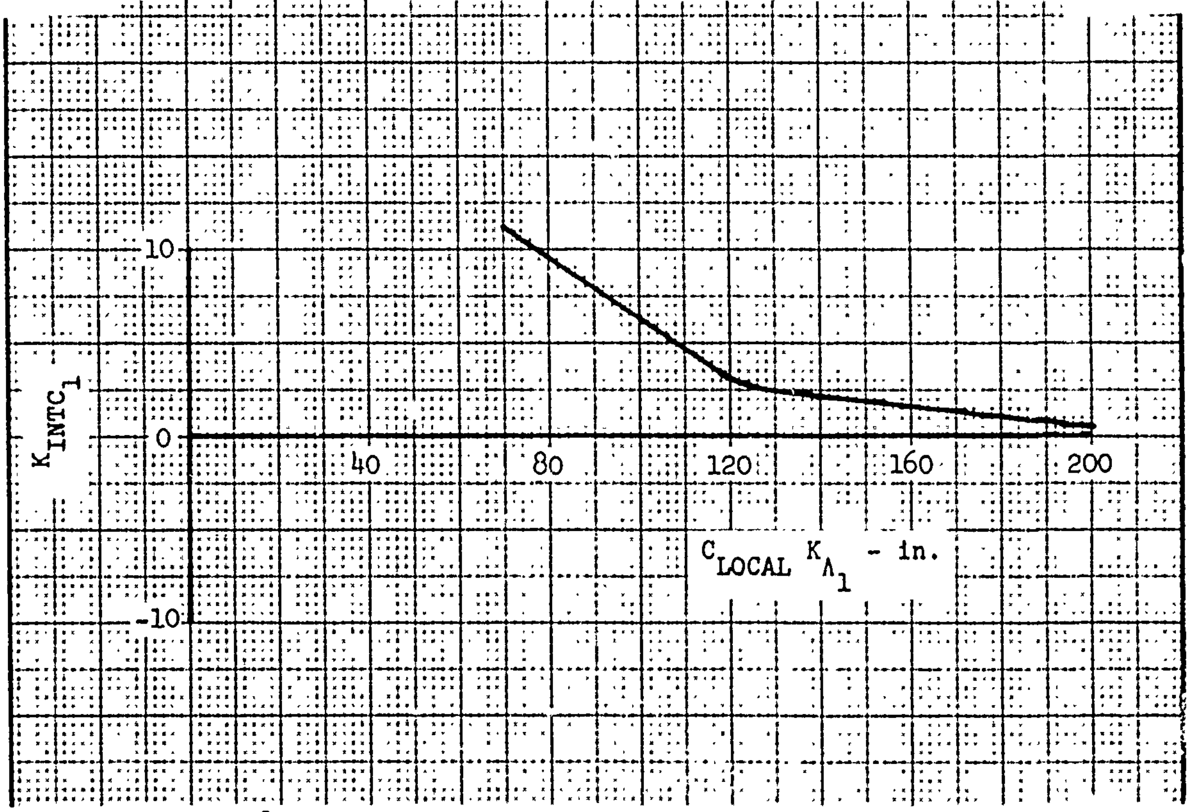

Figure 78. Yawing Moment Intercept - K_{INTC} for Mach Break 1

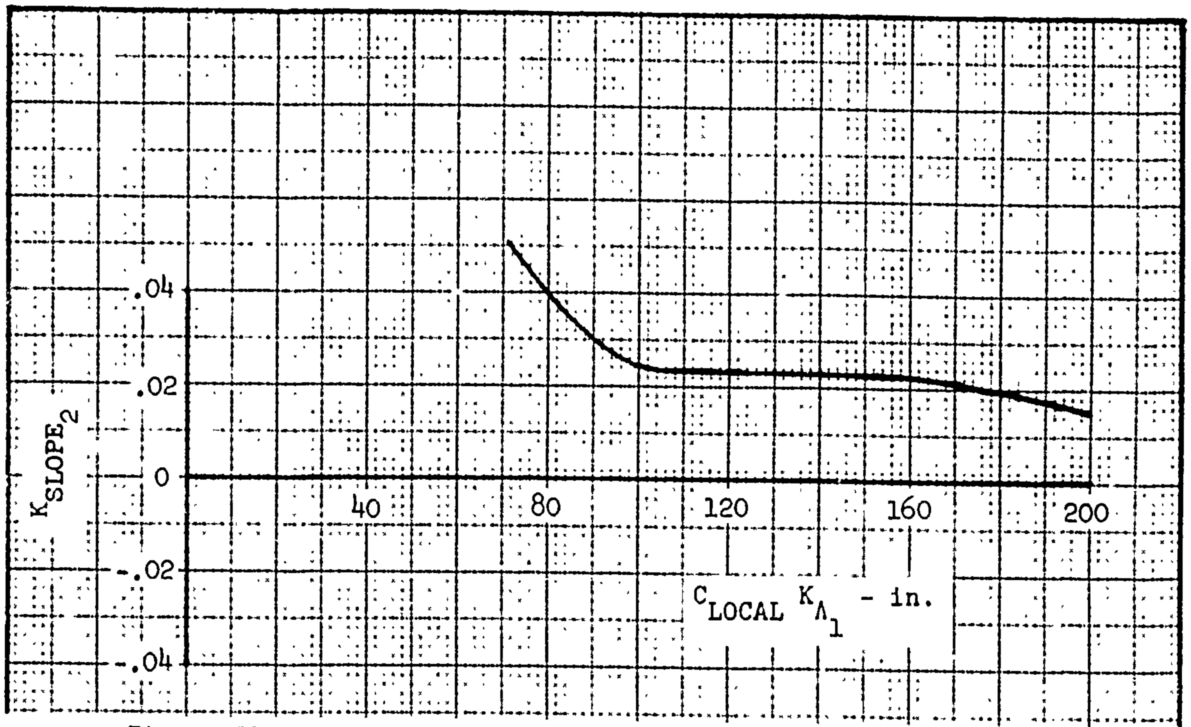

Figure 79. Yawing Moment Intercept - K_{SLOPE} for Mach Break 2

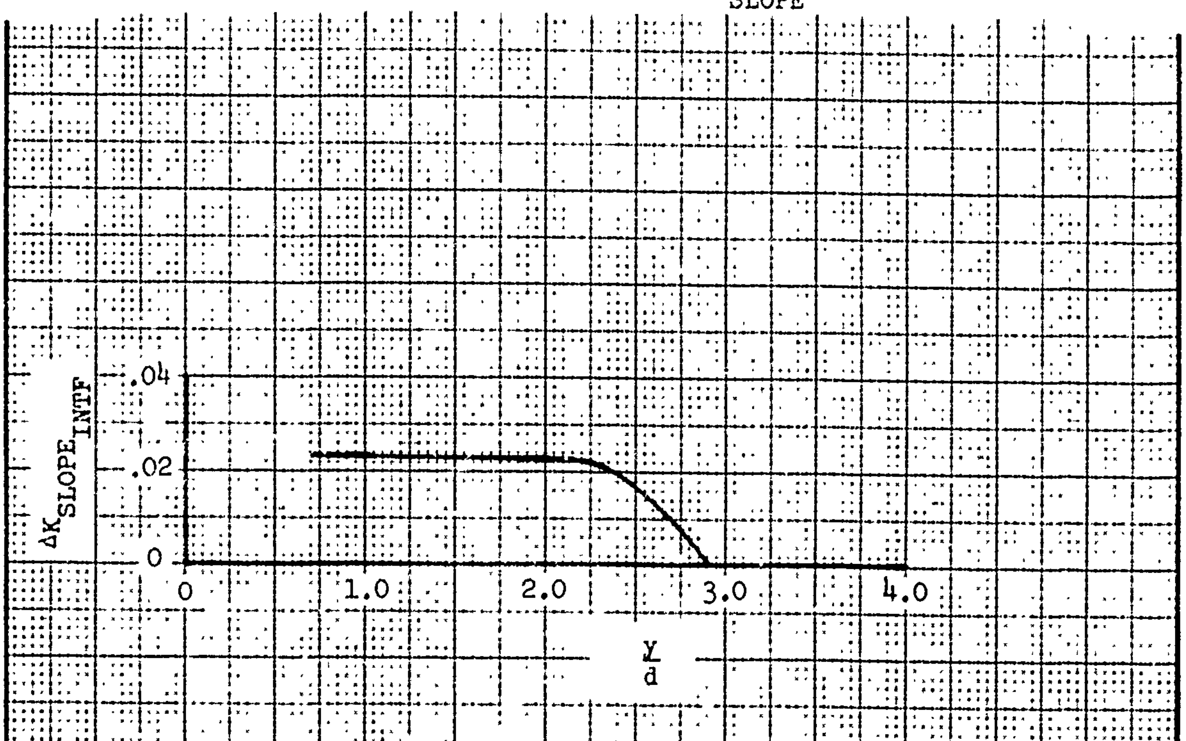

Figure 80. Yawing Moment Intercept - K_{SLOPE_2} Fuselage Interference Correction

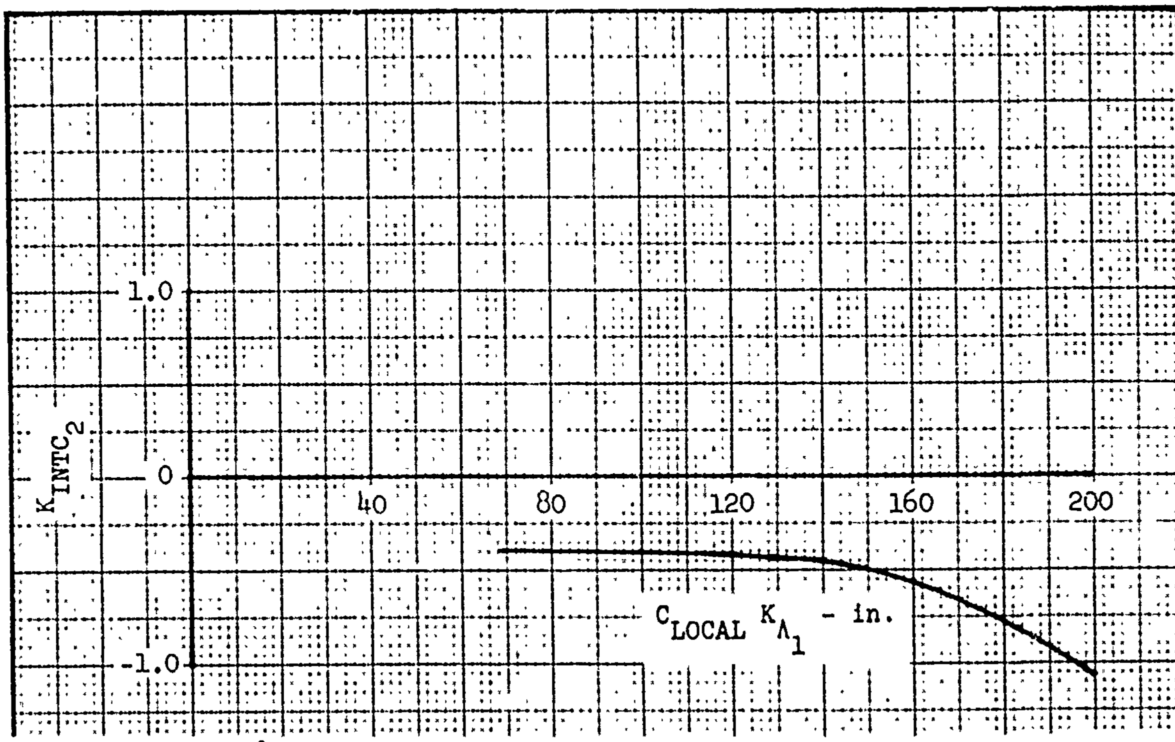

Figure 81. Yawing Moment Intercept - K_{INTC} for Mach Break 2

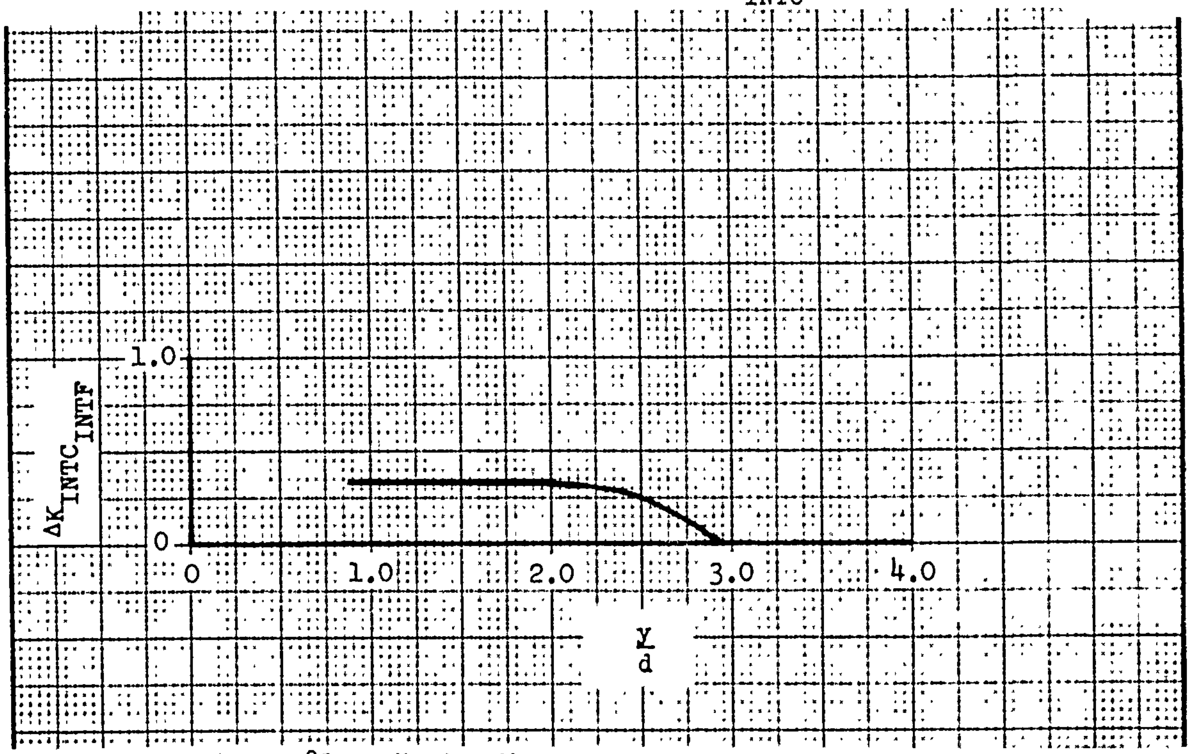

Figure 82. Yawing Moment Intercept - K_{INTC_2} Fuselage Interference Correction

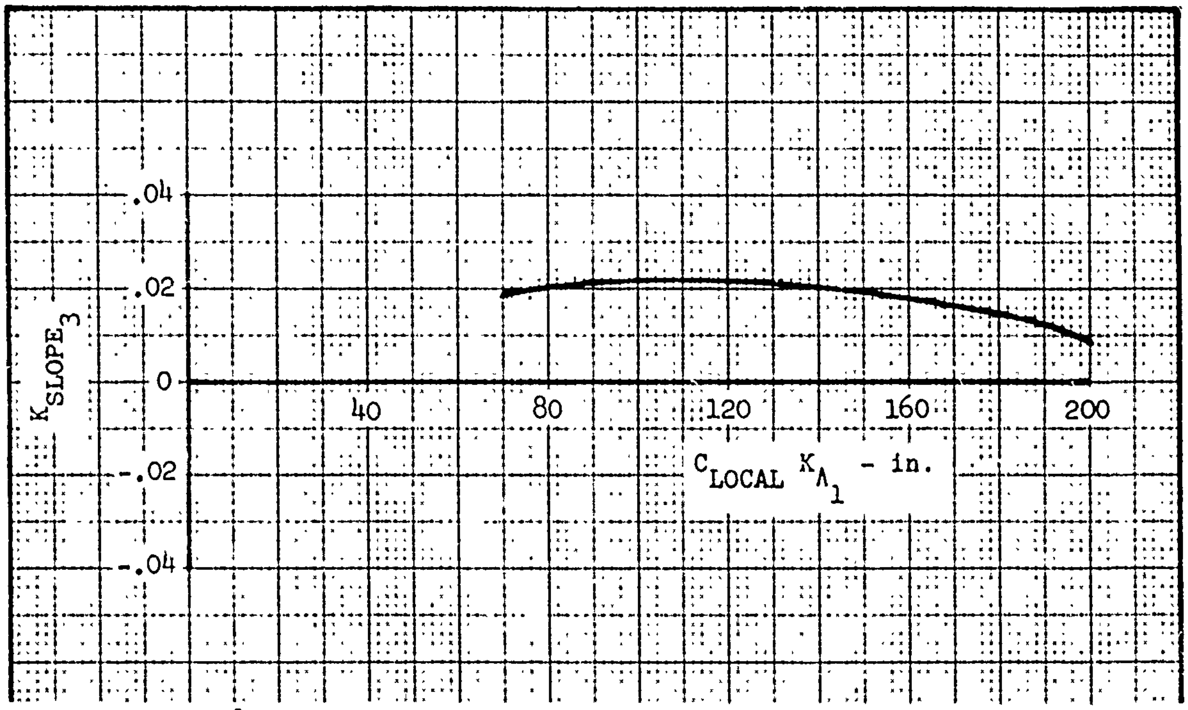

Figure 83. Yawing Moment Intercept - K_{SLOPE} for Mach Break 3

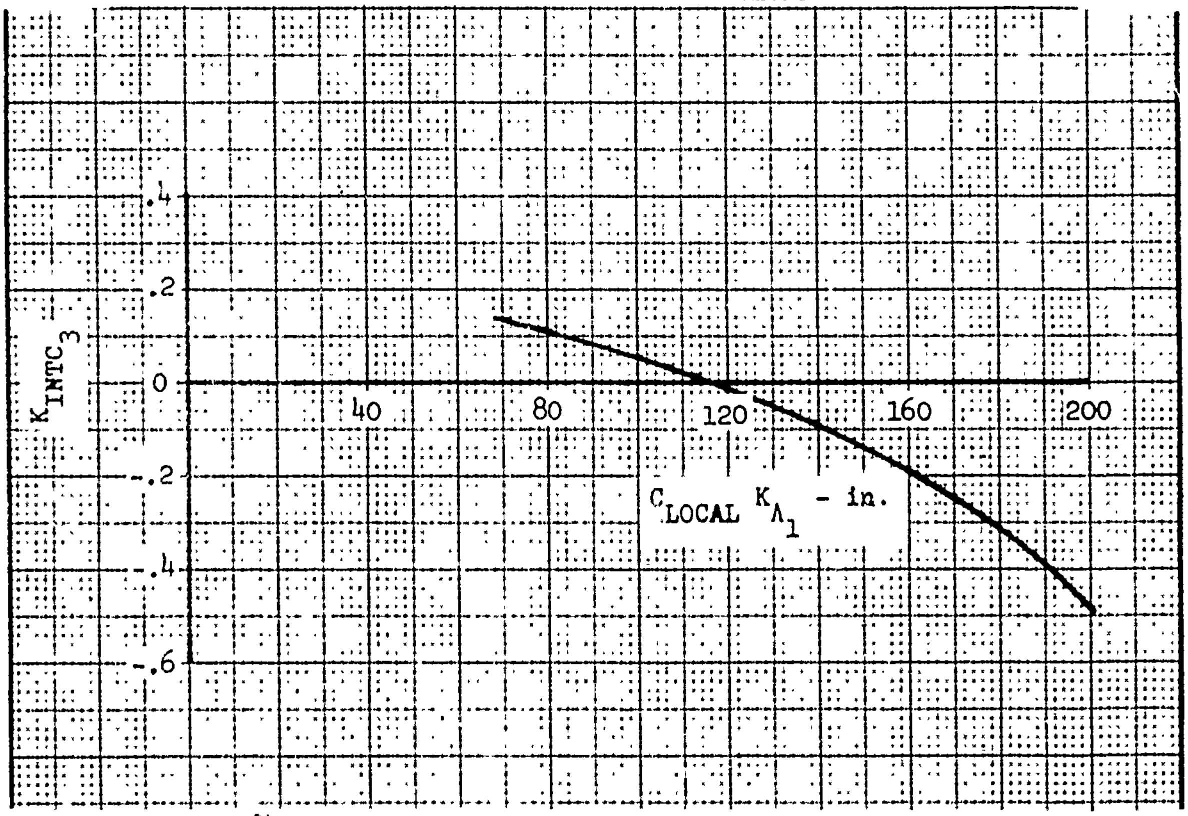

Figure 84. Yawing Moment Intercept - K_{INTC} for Mach Break 3

3.2.2 Increment - Aircraft Yaw

The discussion of incremental yawing moment caused by aircraft yaw is analogous to the discussion of incremental side force found in Subsection 3.1.2.

3.2.2.1 Slope Prediction

The equation for predicting the incremental yawing moment slope per degree β_S, $\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}}$, at a Mach number of 0.5 is presented below.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})\left(\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF}}]S_{REF}d$$

where

K_{SLOPE_1} - Variation of incremental C_{n_α} per degree β_S with $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2 - deg^2}$, Figure 85.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2 . - deg^2 .}$, Figure 86.

$\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$ - Length of the store forward of the local wing chord multiplied by the adjusted nose side projected area and divided by the total store length, in^2.

K_{INTC_1} - Value of $\Delta C_{n_{\alpha_{\beta_S}}}$ when $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 87.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 88.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

Example: Calculate $\Delta\left(\frac{YM}{q}\right)_\alpha$ for a 300-gallon tank on A-7 center pylon at M = 0.5 and $\beta_S = +4°$.

Required for Computation:

$S_{REF} = 3.83$ ft^2

d = 2.2 ft

$\eta' = .27$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_1} = .811$

$\ell_{LE} = 75.1$ in.

L = 226 in.

ADJ.NOSE SPA = 3109 in^2 from Subsection . . 2

$K_{SLOPE_1} = 1.5 \times 10^{-6}$ Figure 85,+ β_S curve

$\Delta K_{SLOPE_{INTF}} = 0.0$ Figure 86,+ β_S curve

$K_{INTC_1} = -.0075$ Figure 87,+ β_S curve

$\Delta K_{INTC_{INTF}} = 0.0$ Figure 88,+ β_S curve

Substituting,

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}} = [(1.5 \times 10^{-6} + 0.0)\left(\frac{(75.1)(3109)}{226}\right) + (-.0075)$$

$$+ 0.0](8.43)$$

$$= -.0762 \ \frac{ft^3}{deg^2}$$

and using the equation from Subsection 3.2.2

$$\Delta\left(\frac{YM}{q}\right)_{\alpha} = \Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}} \cdot \beta_S$$

$$= (-.0762)(+4^{\circ}) = -.305 \ \frac{ft^3}{deg}$$

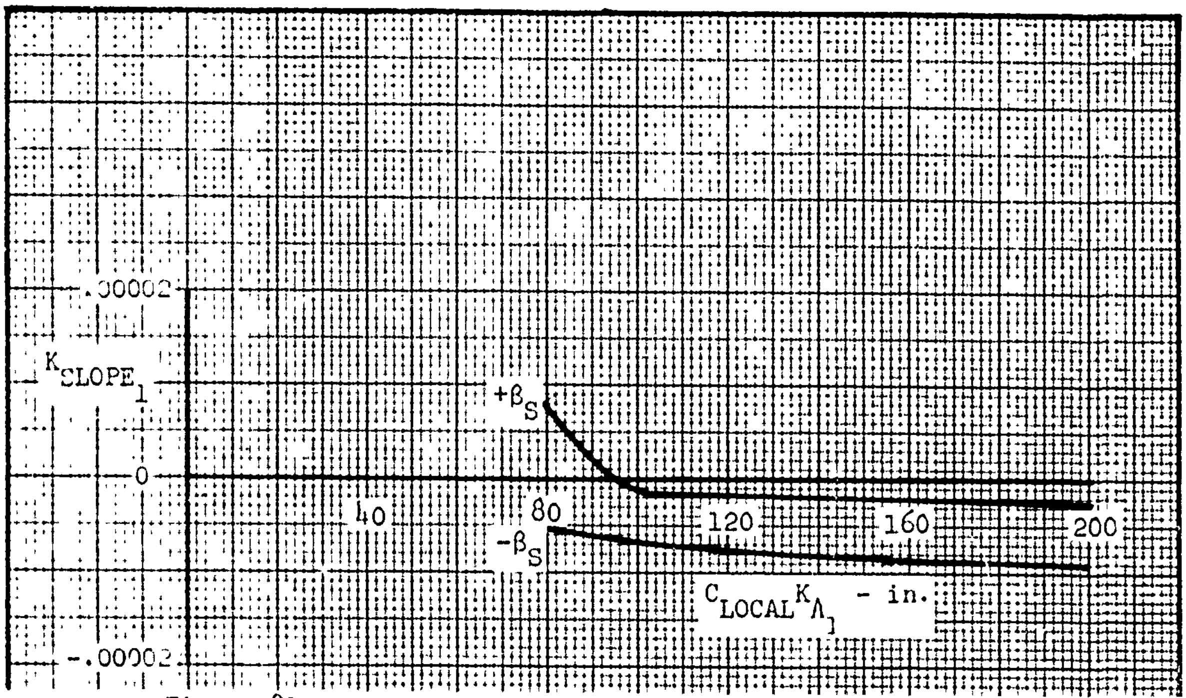

Figure 85. Incremental Yawing Moment Slope Due to Yaw - K_{SLOPE} for Positive and Negative Store Yaw

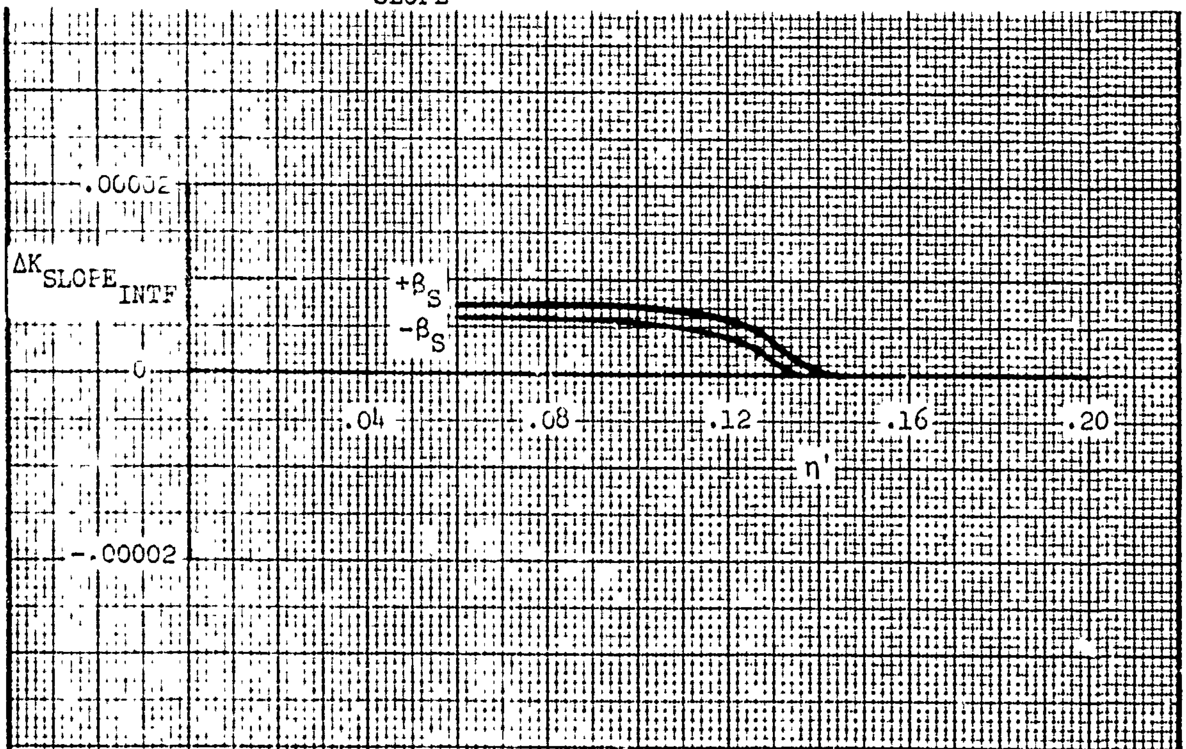

Figure 86. Incremental Yawing Moment Slope Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

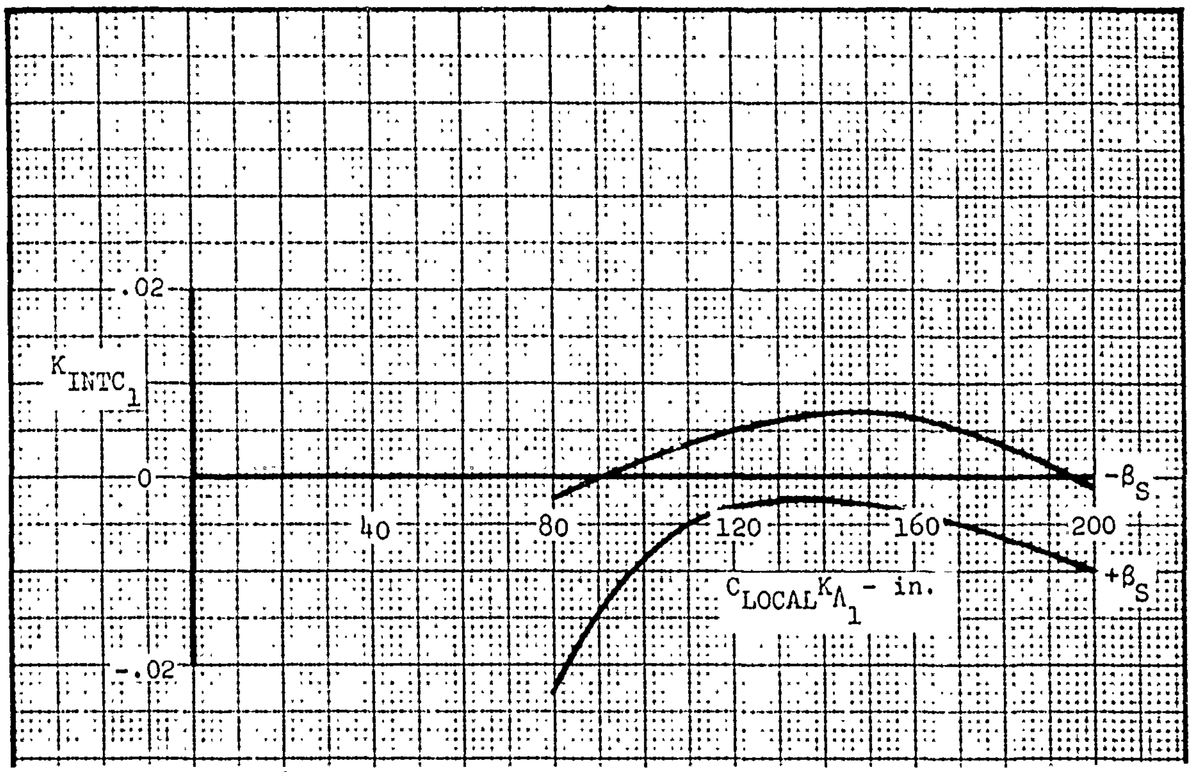

Figure 87. Incremental Yawing Moment Slope Due to Yaw - K_{INTC} for Positive and Negative Store Yaw

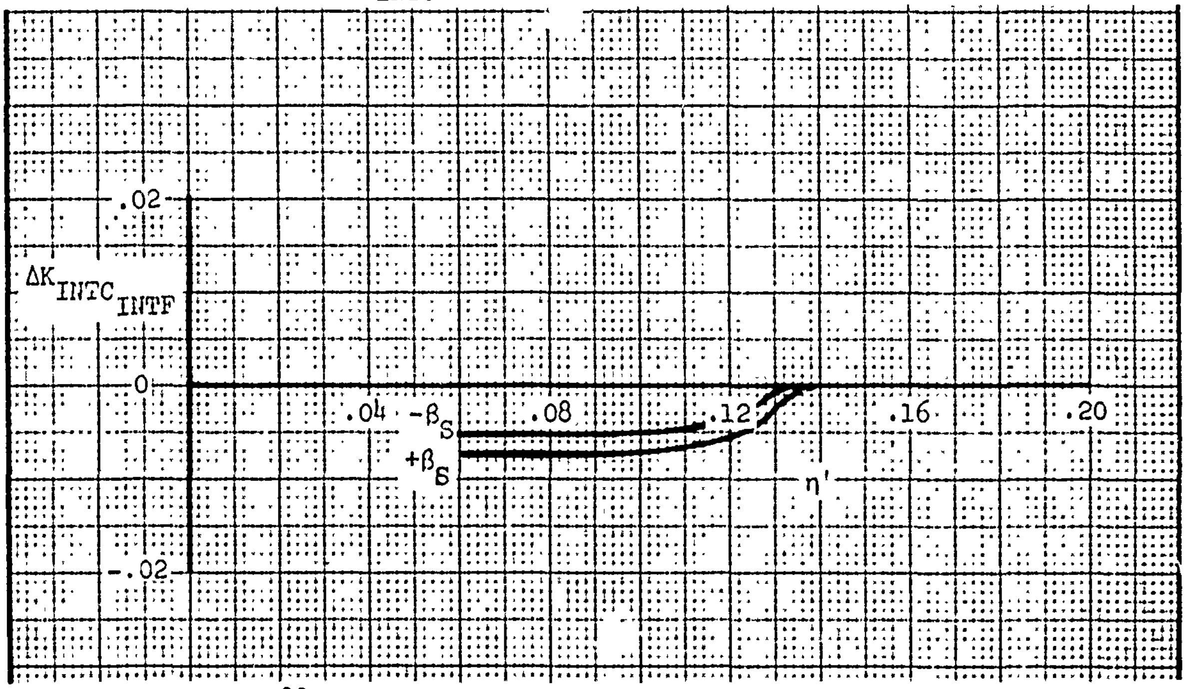

Figure 88. Incremental Yawing Moment Slope Due to Yaw - K_{INTC_1}, Fuselage Interference Correction

3.2.2.2 Slope Mach Number Correction

To compute the incremental yawing moment slope per degree β_S, $\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}}$, between M = 0.5 and M = 2.0, use the equation below.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}} = \Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$$

where:

$\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}}$ - Incremental yawing moment slope per degree β_S predicted at M = 0.5, from Subsection 3.2.2.1.

$\Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ - Incremental change with Mach number of the incremental yawing moment slope per degree β_S at M = 0.5.

A generalized curve depicting the incremental yawing moment per degree β_S variation with Mach number is given by Figure 89.

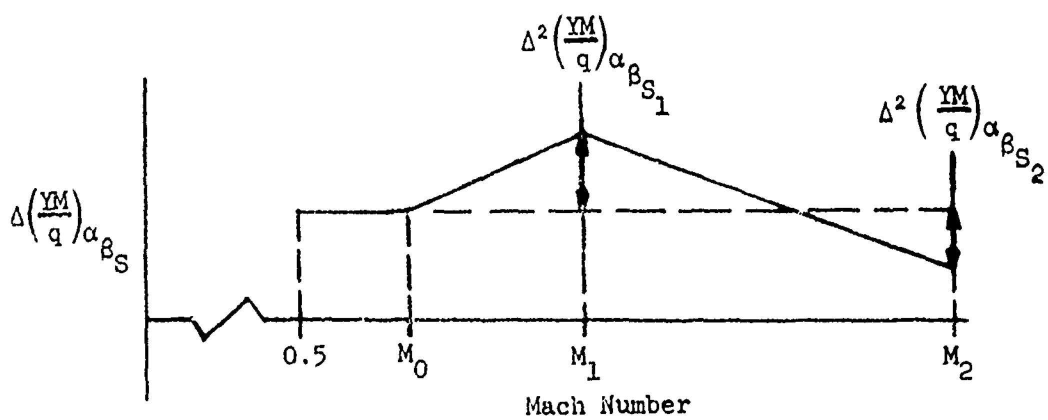

Figure 89. Incremental Yawing Moment Slope Due to Yaw - Generalized Mach Number Variation

The slope variation with Mach number has been fitted by straight line segments with breaks at Mach numbers defined by M_0, M_1 and M_2. The Mach break points are presented in Figures 90 and 91 as a

function of $C_{LOCAL}K_{\Lambda_1}$. M_0 is the Mach number where the slope initially changes from the value predicted at M = 0.5. Equations predicting the incremental changes from the M = 0.5 value at each of the remaining Mach break points follow.

Break 1 (M_1):

$$\Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_1}}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF_1}})\left(\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF_1}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental $C_{n_{\alpha_1}}$ per degree β_S with $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2 - deg^2}$, Figure 92.

$\Delta K_{SLOPE_{INTF_1}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2 - deg^2}$, Figure 93.

$\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1

K_{INTC_1} - Value of $\Delta C_{n_{\alpha_{\beta_{S_1}}}}$ when $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 94.

$\Delta K_{INTC_{INTF_1}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 95.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

Break 2 (M_2):

$$\Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_2}}} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF_2}})\left(\frac{\ell_{LE}\,ADJ.NOSE\ SPA}{L}\right) + K_{INTC_2} + \Delta K_{INTC_{INTF_2}}]S_{REF}d$$

where:

K_{SLOPE_2} - Variation of incremental $C_{n_{\alpha_2}}$ per degree β_S with $\frac{\ell_{LE}\,ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2 - deg^2}$, Figure 96.

$\Delta K_{SLOPE_{INTF_2}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2 - deg^2}$, Figure 97.

$\frac{\ell_{LE}\,ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1.

K_{INTC_2} - Value of $\Delta C_{n_{\alpha_{\beta_{S_2}}}}$ when $\frac{\ell_{LE}\,ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 98.

$\Delta K_{INTC_{INTF_2}}$ - Incremental change in K_{INTC_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 99.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

To compute $\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}}$ at M = x, first determine from Figures 90 and 91 between which Mach number break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_S}}$ at M = x from the following relation.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}} = \Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M_{LOW}}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)$$

$$\left[\Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M_{HI}}}}} - \Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M_{LOW}}}}}\right]$$

If x > 1.6, the value of $\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ is equal to the value given at M = 1.6.

If $x \leq M_0$, the value of $\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ is equal to the value at M = 0.5 from Subsection 3.2.2.1 (the initial term of the above equation).

Example: Calculate the value of $\Delta\left(\frac{YM}{q}\right)_{\alpha}$ for a 300-gallon tank on the A-7 center pylon at M = 1.4 and $\beta_S = +4°$.

Required for Computation:

$S_{REF} = 3.83\ ft^2$

d = 2.2 ft

$\eta' = .27$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_1} = .811$

$\ell_{LE} = 75.1$ in.

$L = 226$ in.

ADJ.NOSE SPA = 3109 in^2 from Subsection 2.3.2

From Figure 90 , $M = 1.4$ lies between M_1 and M_2

So $M_{LOW} = M_1 = 1.15$, and $M_{HI} = M_2 = 1.6$.

Break 1 (M_1):

$K_{SLOPE_1} = -1.5 \times 10^{-6}$ - Figure 92, $+\beta_S$ curve

$\Delta K_{SLOPE_{INTF_1}} = 0.0$ - Figure 93, $+\beta_S$ curve

$K_{INTC_1} = .0088$ - Figure 94, $+\beta_S$ curve

$\Delta K_{INTC_{INTF_1}} = 0.0$ - Figure 95, $+\beta_S$ curve.

$$\Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_1}}} = [(-1.5 \times 10^{-6} + 0.0)\left(\frac{(75.1)(3109)}{226}\right) + .0088 + 0.0](8.43)$$

$$= .0611 \frac{ft^3}{deg^2}$$

Break 2 (M2):

$K_{SLOPE_2} = 8.8 \times 10^{-6}$ - Figure 96, $+\beta_S$ curve

$$\Delta K_{SLOPE_{INTF_2}} = 0.0 \quad \text{- Figure 97, } +\beta_S \text{ curve}$$

$$K_{INTC_2} = -.0110 \quad \text{- Figure 98, } +\beta_S \text{ curve}$$

$$\Delta K_{INTC_{INTF_2}} = 0.0 \quad \text{- Figure 99, } +\beta_S \text{ curve}$$

$$\Delta^2\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_2}}} = [(8.8 \times 10^{-6} + 0.0)(1033) + (-.011) + 0.0](8.43)$$
$$= -.0161 \frac{ft^3}{deg^2}$$

then:

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=1.4}}}} = -.0762 + .0611 + \left(\frac{1.4 - 1.15}{1.6 - 1.15}\right)[-.0161 - .0611]$$
$$= -.0580 \frac{ft^3}{deg^2}$$

and using the equation from Subsection 3.2.2.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{M=1.4}} = \Delta\left(\frac{YM}{q}\right)_{\alpha_{\beta_{S_{M=1.4}}}} \cdot \beta_S$$

$$= (-.058)\ (4) = -.232 \frac{ft^3}{deg}.$$

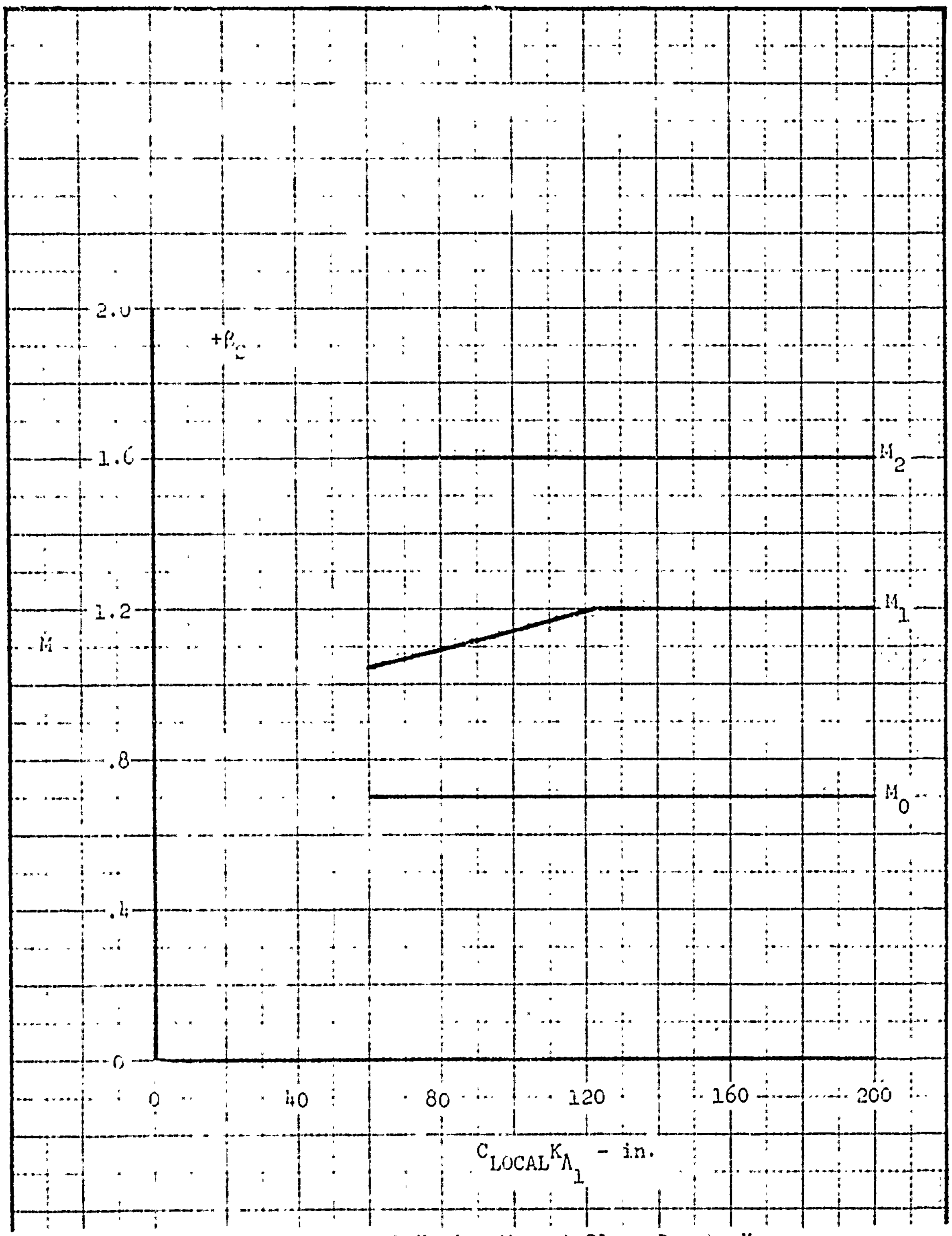

Figure 90. Incremental Yawing Moment Slope Due to Yaw - Mach Number Break Points for Positive Store Yaw

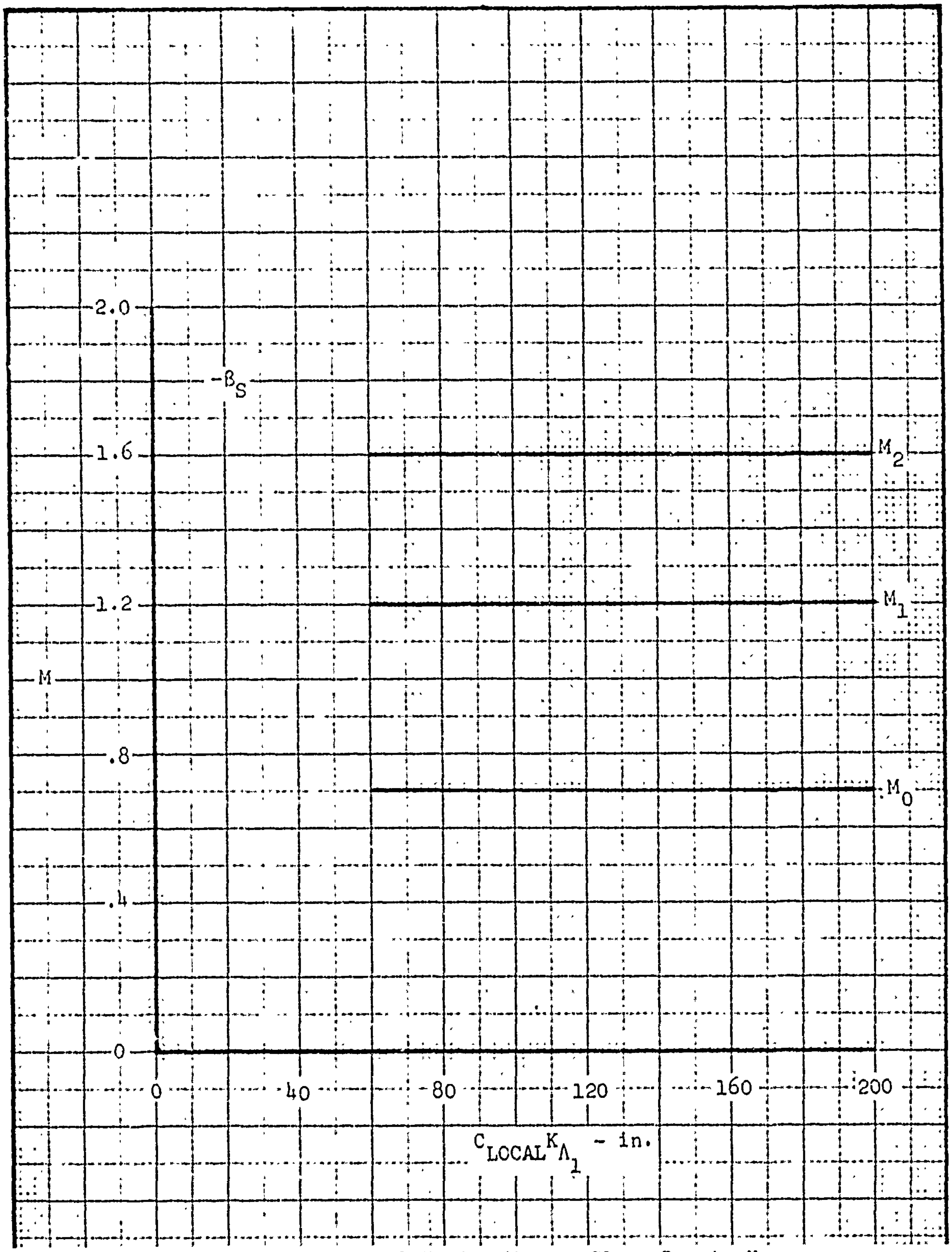

Figure 91. Incremental Yawing Moment Slope Due to Yaw - Mach Number Break Points for Negative Store Yaw

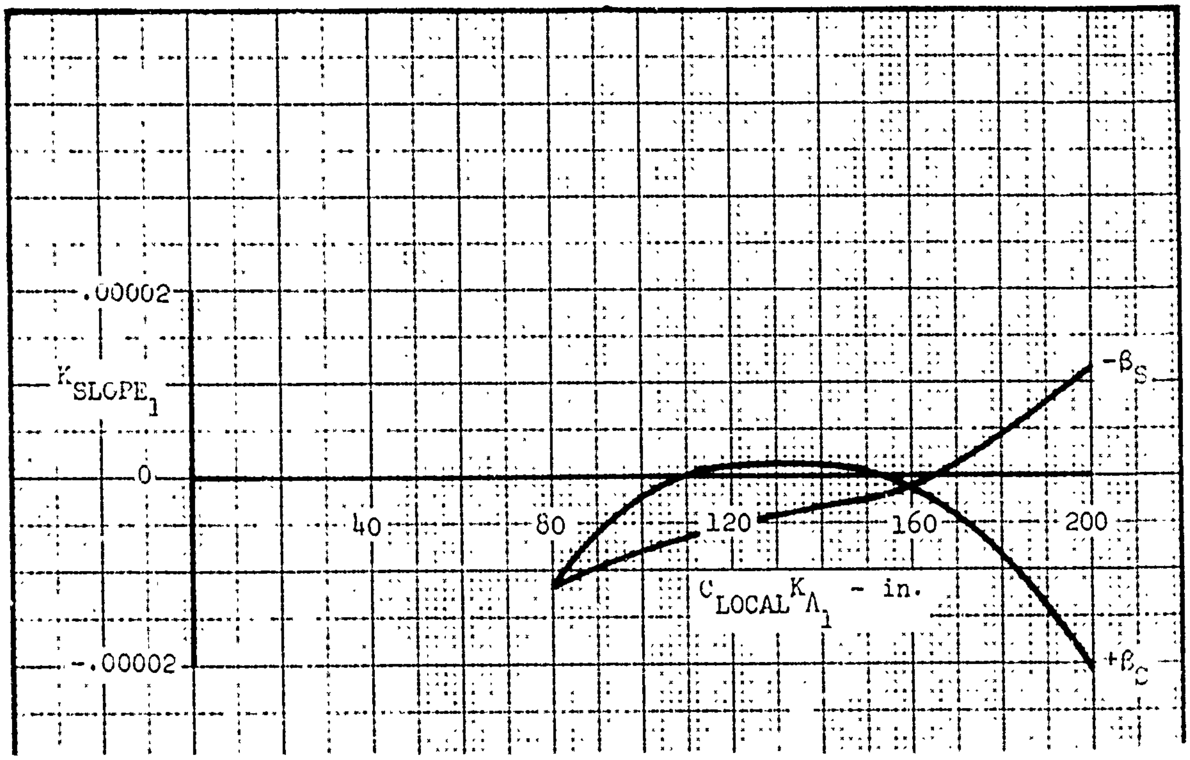

Figure 92. Incremental Yawing Moment Slope Due to Yaw - K_{SLOPE} for Mach Break 1

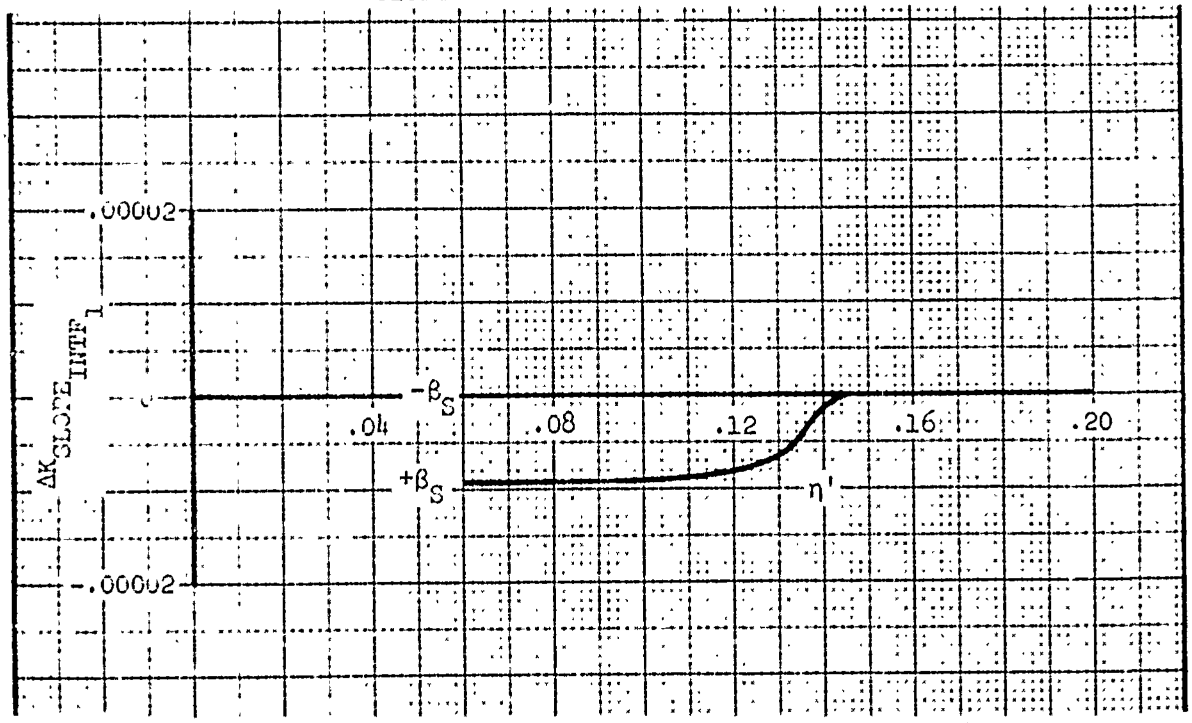

Figure 93. Incremental Yawing Moment Slope Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

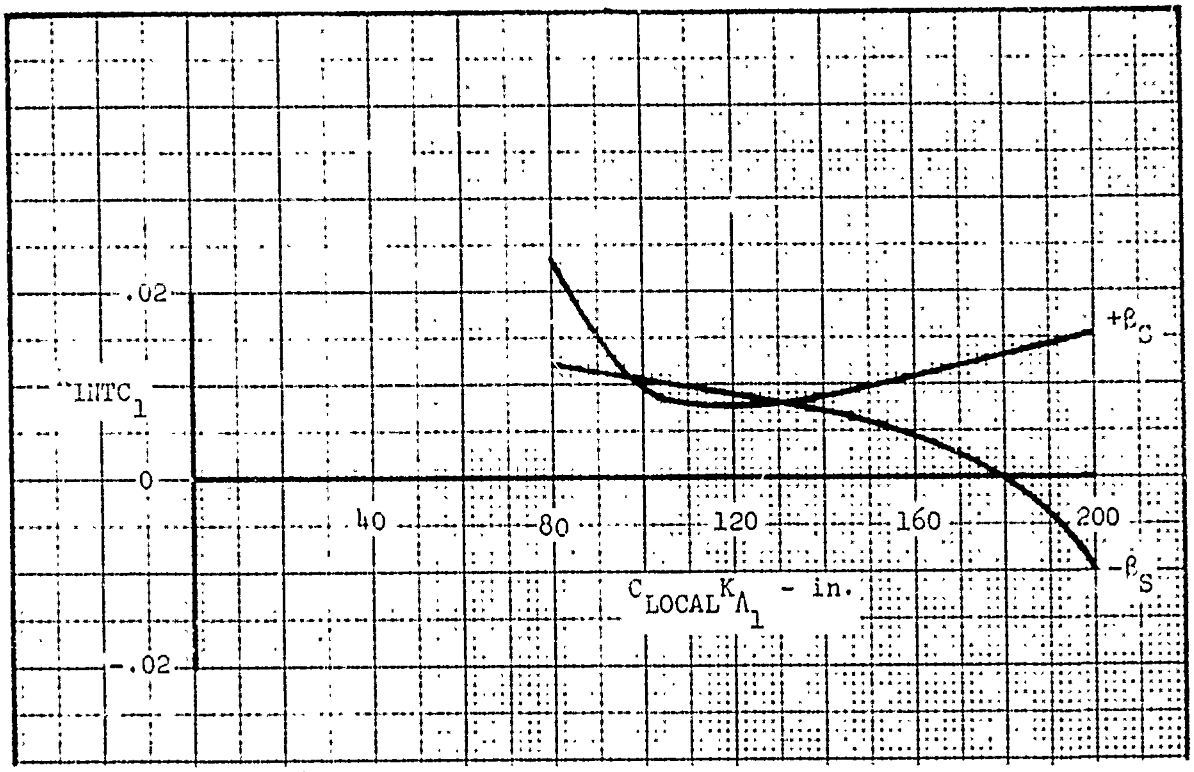

Figure 94. Incremental Yawing Moment Slope Due to Yaw - K_{INTC} for Mach Break 1

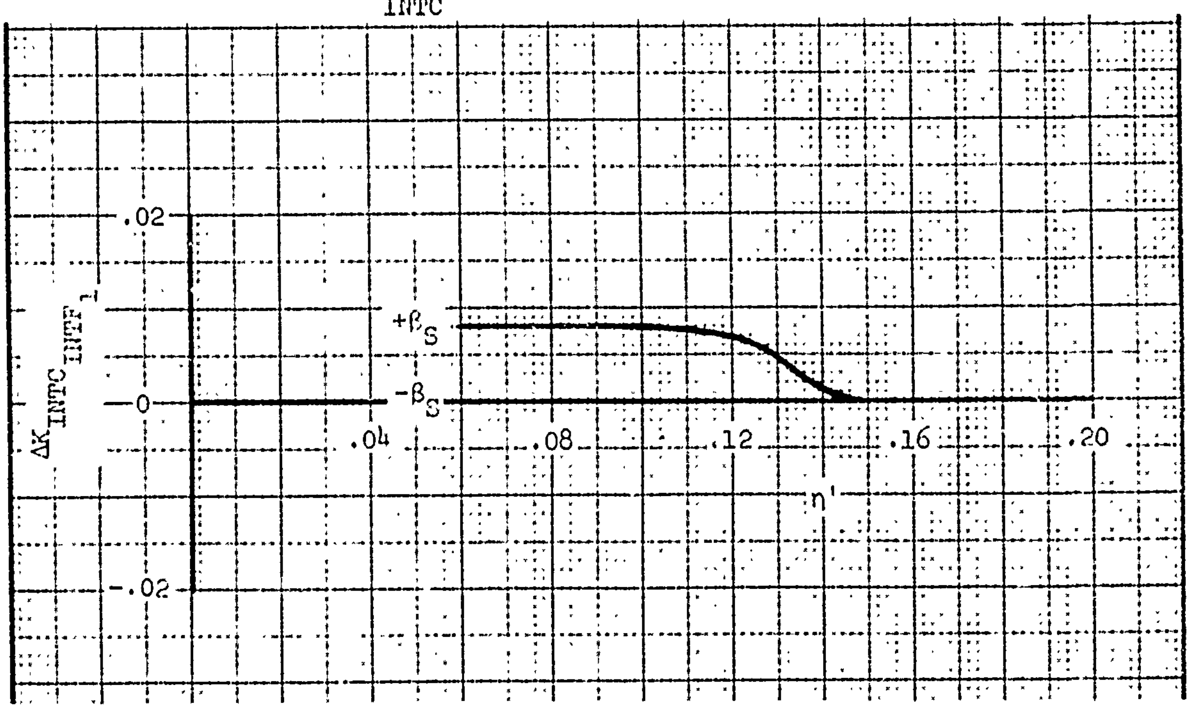

Figure 95. Incremental Yawing Moment Slope Due to Yaw - K_{INTC_1} Fuselage Interference Correction

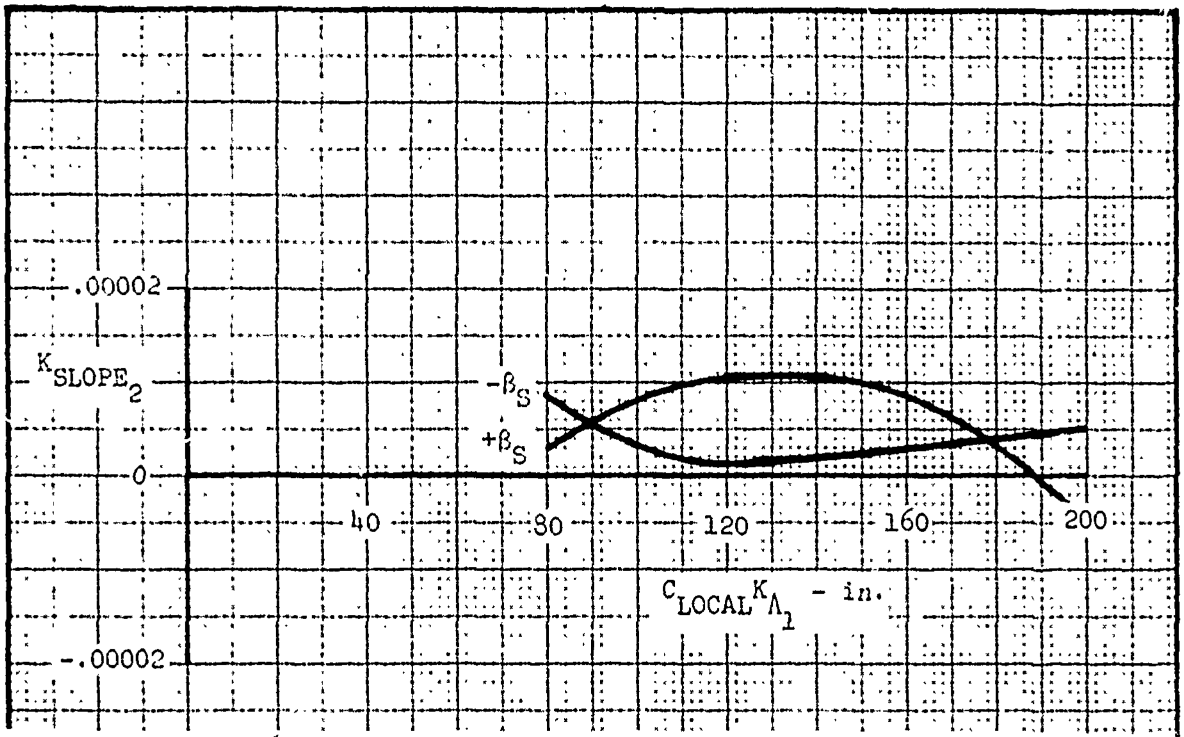

Figure 96. Incremental Yawing Moment Slope Due to Yaw - K_{SLOPE} for Mach Break 2

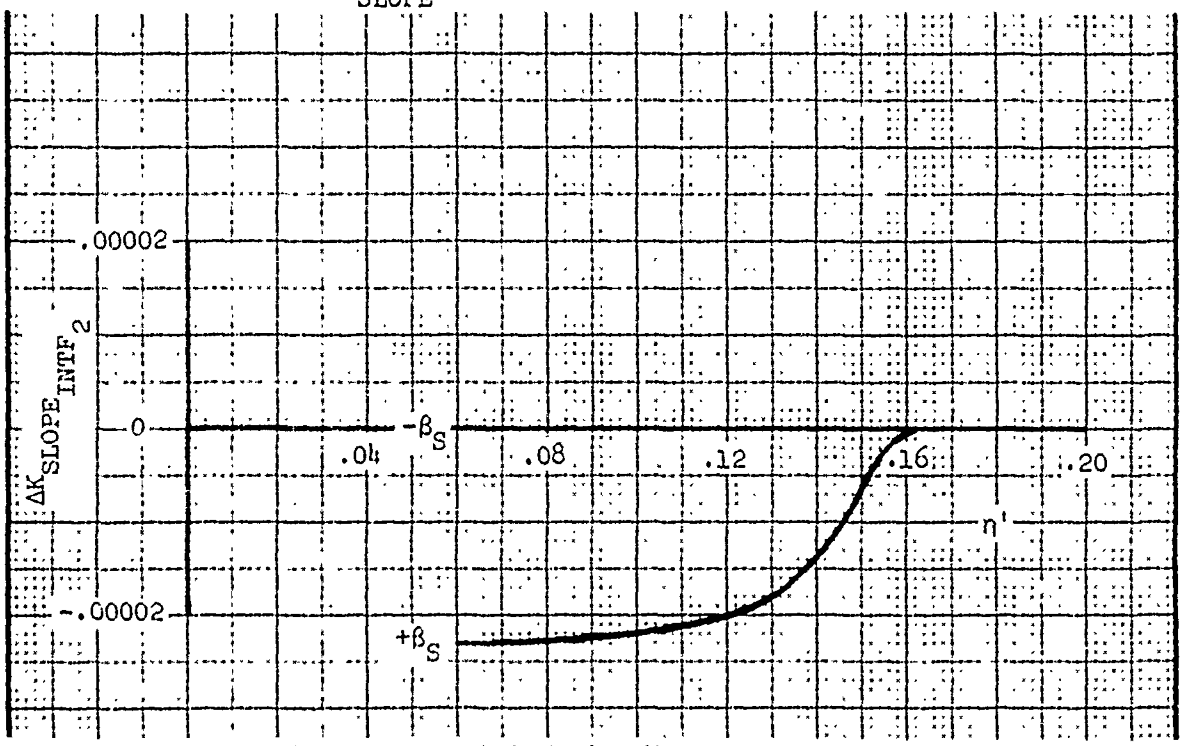

Figure 97. Incremental Yawing Moment Slope Due to Yaw - K_{SLOPE_2} Fuselage Interference Correction

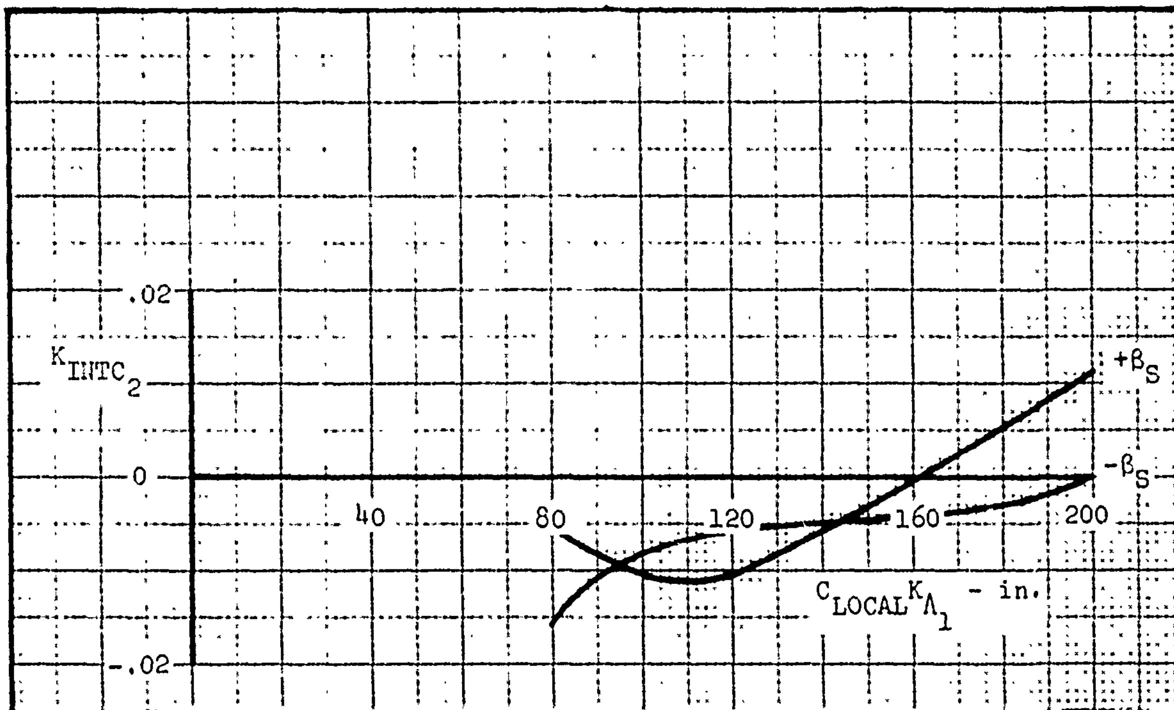

Figure 98. Incremental Yawing Moment Slope Due to Yaw - K_{INTC} for Mach Break 2

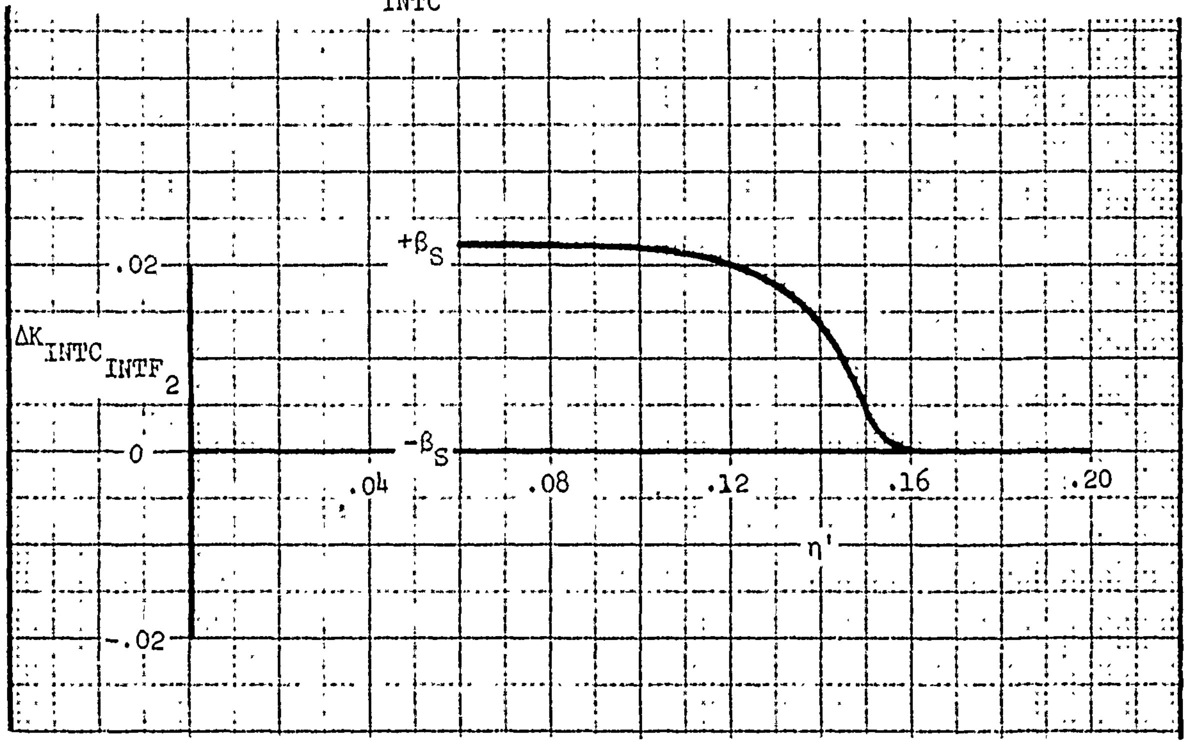

Figure 99. Incremental Yawing Moment Slope Due to Yaw - K_{INTC_2} Fuselage Interference Correction

3.2.2.3 Intercept Prediction

The equation for predicting the incremental yawing moment intercept per degree β_S, $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_S}}$, at Mach number = 0.5 follows:

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_S}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})\left(\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental $C_{n_{\alpha=0}}$ per degree β_S with $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2 - deg}$, Figure 100.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2 - deg}$ Figure 101.

$\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1.

K_{INTC_1} - Value of $\Delta C_{n_{\alpha=0_{\beta_S}}}$ when $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{deg}$, Figure 102.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage forhigh wing aircraft, $\frac{1}{deg}$, Figure 103.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

A numerical example illustrating the use of the preceding equation is contained in Subsection 3.2.2.1.

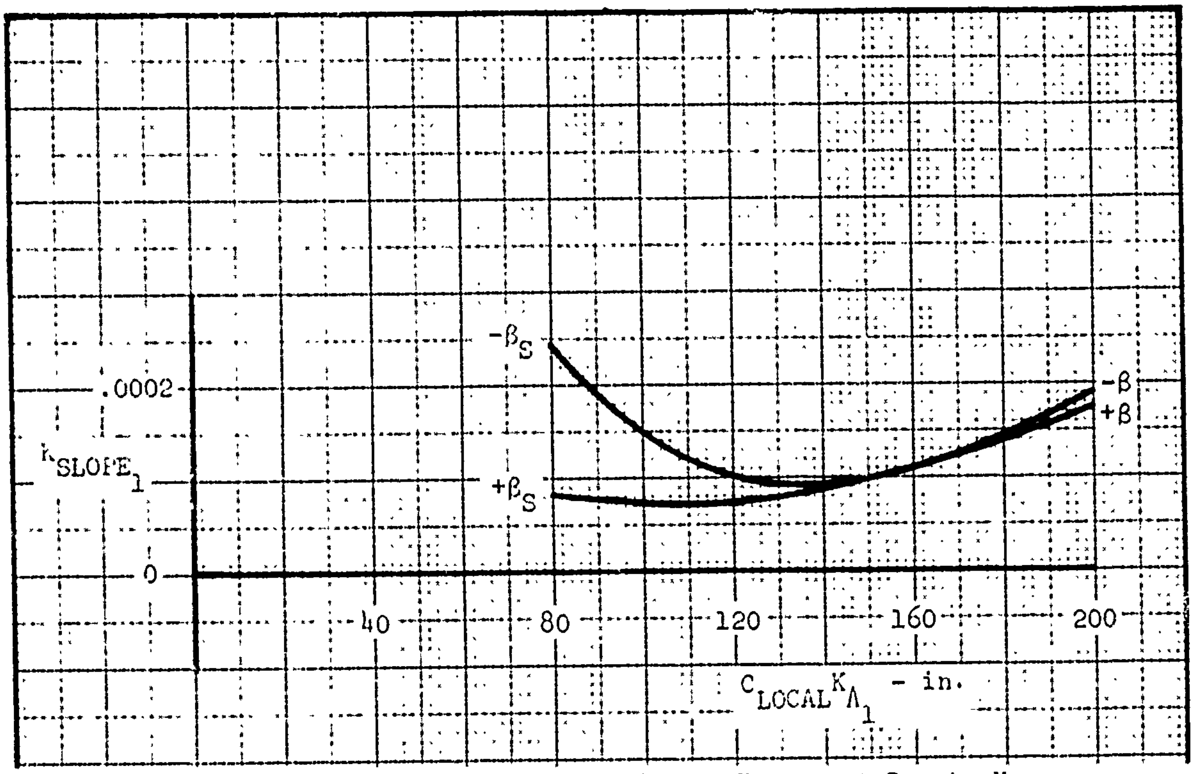

Figure 100. Incremental Yawing Moment Intercept Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

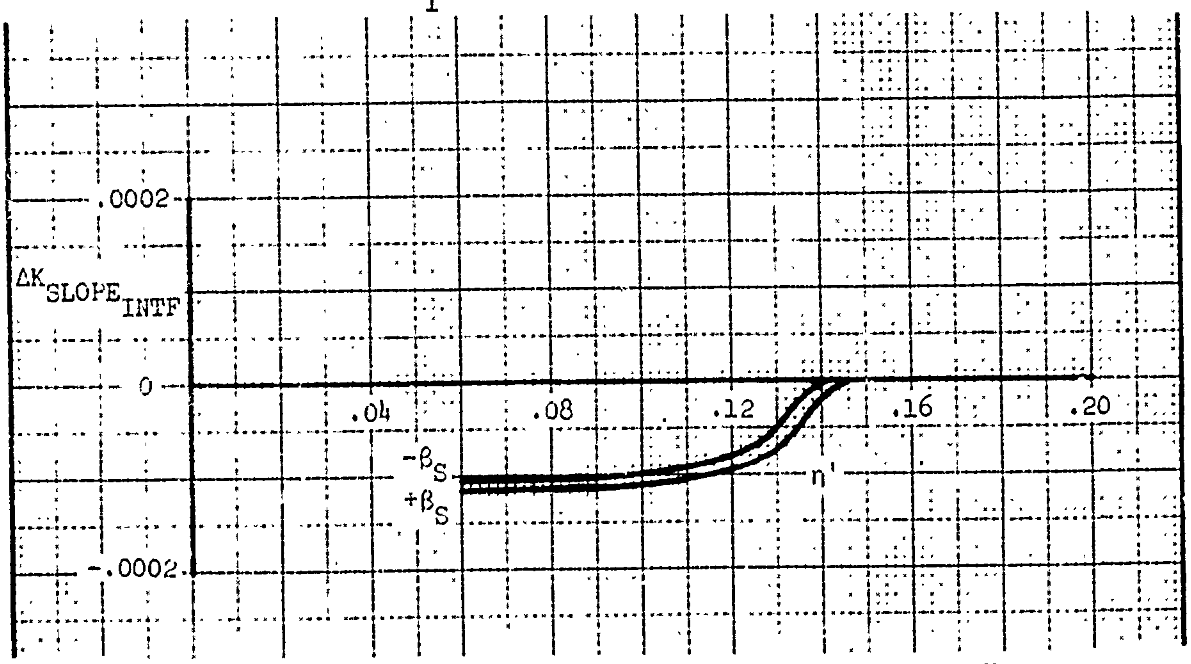

Figure 101. Incremental Yawing Moment Intercept Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

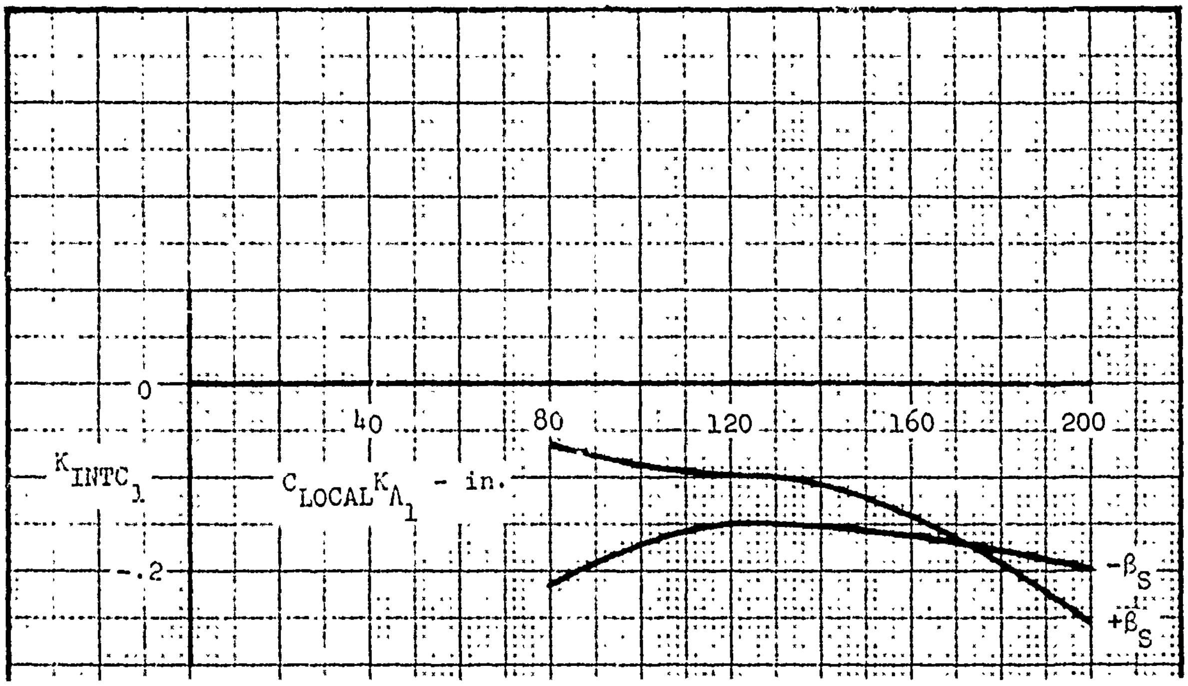

Figure 102. Incremental Yawing Moment Intercept Due to Yaw - K_{INTC_1} for Positive and Negative Store Yaw

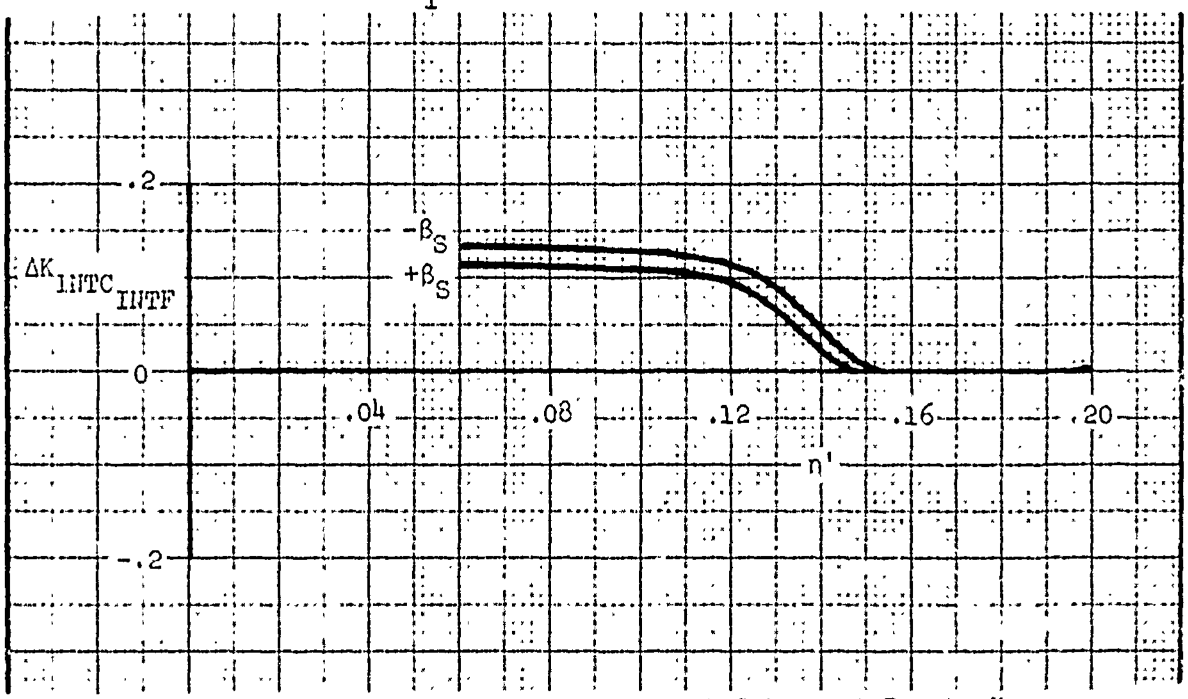

Figure 103. Incremental Yawing Moment Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

3.2.2.4 Intercept Mach Number Correction

The procedure for calculating the Mach number correction for incremental yawing moment intercept per degree β_S is the same as that presented in Subsection 3.2.2.2 for incremental yawing moment slope per degree β_S Mach number correction.

The incremental yawing moment intercept variation with Mach number has been approximated by a series of linear segments with breaks occurring at Mach numbers defined by M_0, M_1, and M_2 as in Figure 104.

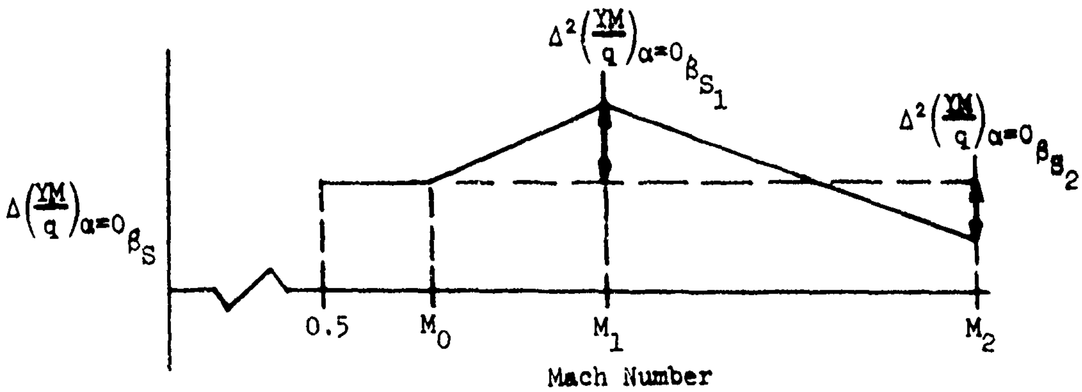

Figure 104. Incremental Yawing Moment Intercept Due to Yaw - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figures 105 and 106 as a function of $C_{LOCAL}\,K_{\Lambda_1}$. M_0 is the Mach number where the intercept initially deviates from the incremental intercept value predicted at M=0.5. Equations predicting the incremental changes from the M = 0.5 value at each of the remaining Mach break points follow.

Break 1 (M_1):

$$\Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_1}}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF_1}})\left(\frac{\ell_{LE}\ ADJ.NOSE\ SPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF_1}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental $C_{n_{\alpha=0_1}}$ per degree β_S with $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2 - deg}$, Figure 107.

$\Delta K_{SLOPE_{INTF_1}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2 - deg}$, Figure 108.

$\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1.

K_{INTC_1} - Value of $\Delta C_{n_{\alpha=0_{\beta_{S_1}}}}$ when $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{deg}$, Figure 109.

$\Delta K_{INTC_{INTF_1}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 110.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

Break 2 (M_2):

$$\Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_2}}} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF_2}})\left(\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}\right) + K_{INTC_2} + \Delta K_{INTC_{INTF_2}}]S_{REF}d$$

where:

K_{SLOPE_2} - Variation of incremental $C_{n_{\alpha=0_2}}$ per degree β_S with $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2 - deg}$, Figure 111.

$\Delta K_{SLOPE_{INTF_2}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in^2 - deg}$ Figure 112.

$\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1.

K_{INTC_2} - Value of $\Delta C_{n_{\alpha=0_{\beta_{S_2}}}}$ when $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$ $= 0$, $\frac{1}{deg}$, Figure 113.

$\Delta K_{INTC_{INTF_2}}$ - Incremental change in K_{INTC_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 114.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

To compute $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_S}}$ at $M = x$, first determine from Figure 105 or 106 between which Mach number break points $M = x$ occurs. Let M_{LOW} be the lower Mach break point and M_{HI} be the higher break point.

Compute $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = x from the following relation.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M=x}}}} = \Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M_{LOW}}}}} + \left(\frac{X - M_{LOW}}{M_{HI} - M_{LOW}}\right)\left[\Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M_{HI}}}}} - \Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M_{LOW}}}}}\right]$$

If $x > M = 1.6$, the value of $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M=x}}}}$ is equal to the value at $M = 1.6$.

If $x \leq M_0$, the value of $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{\beta_{S_{M=x}}}}$ is equal to the value at $M = 0.5$ from Subsection 3.2.2.3 (the initial term of the above equation).

A numerical example illustrating the use of the preceding equation is contained in Subsection 3.2.2.2.

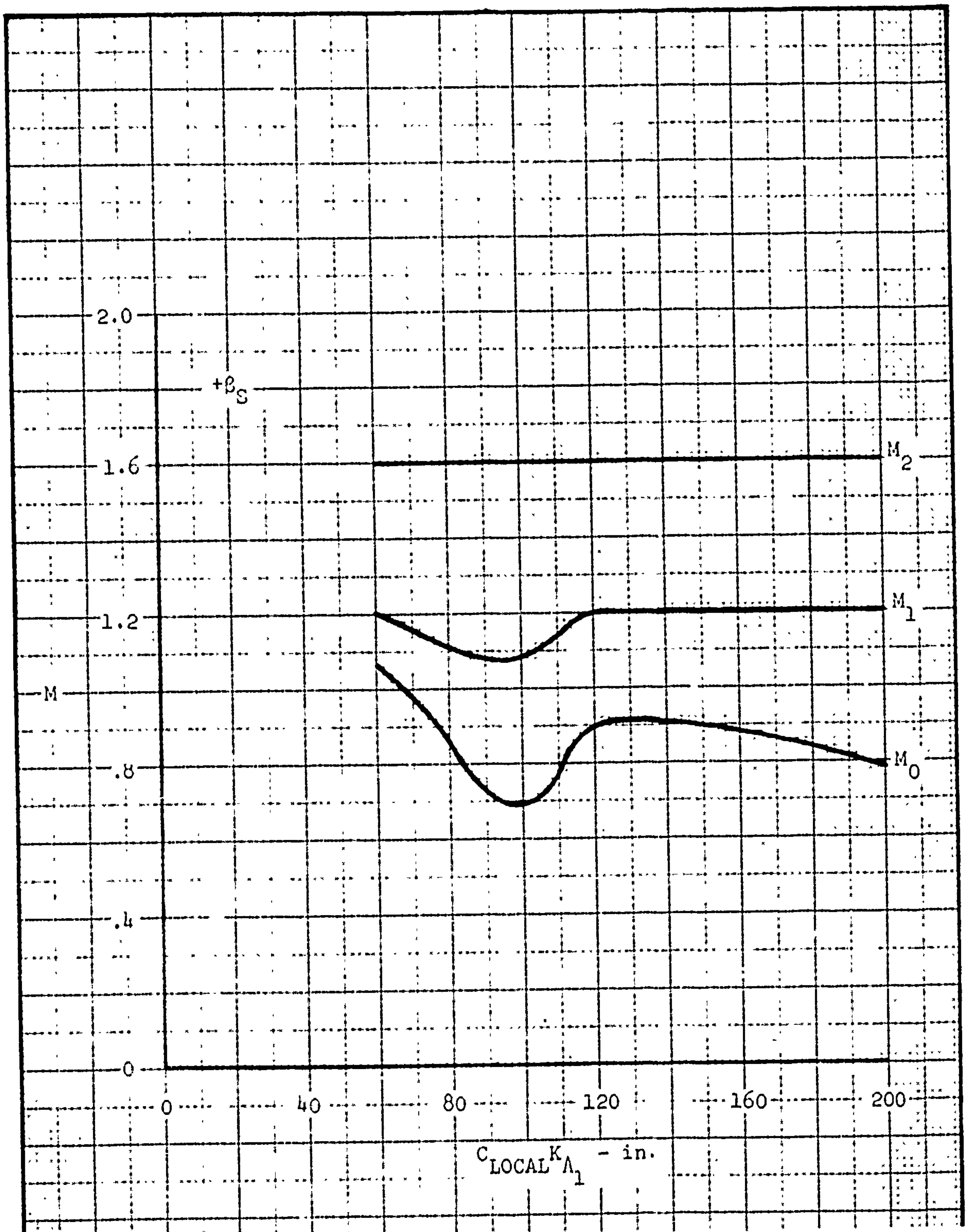

Figure 105. Incremental Yawing Moment Intercept Due to Yaw - Mach Number Break Points for Positive Store Yaw

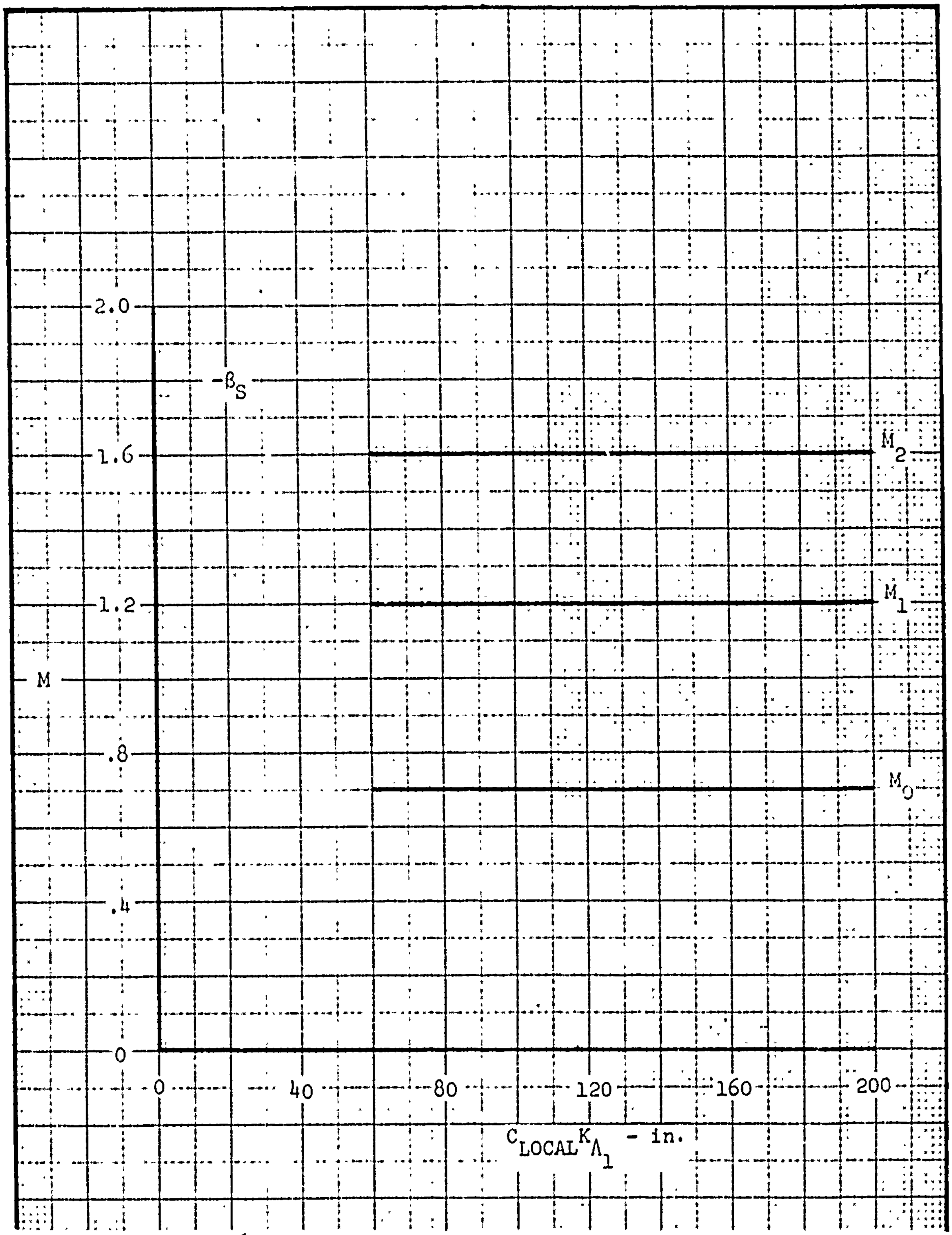

Figure 106. Incremental Yawing Moment Intercept Due to Yaw - Mach Number Break Points for Negative Store Yaw

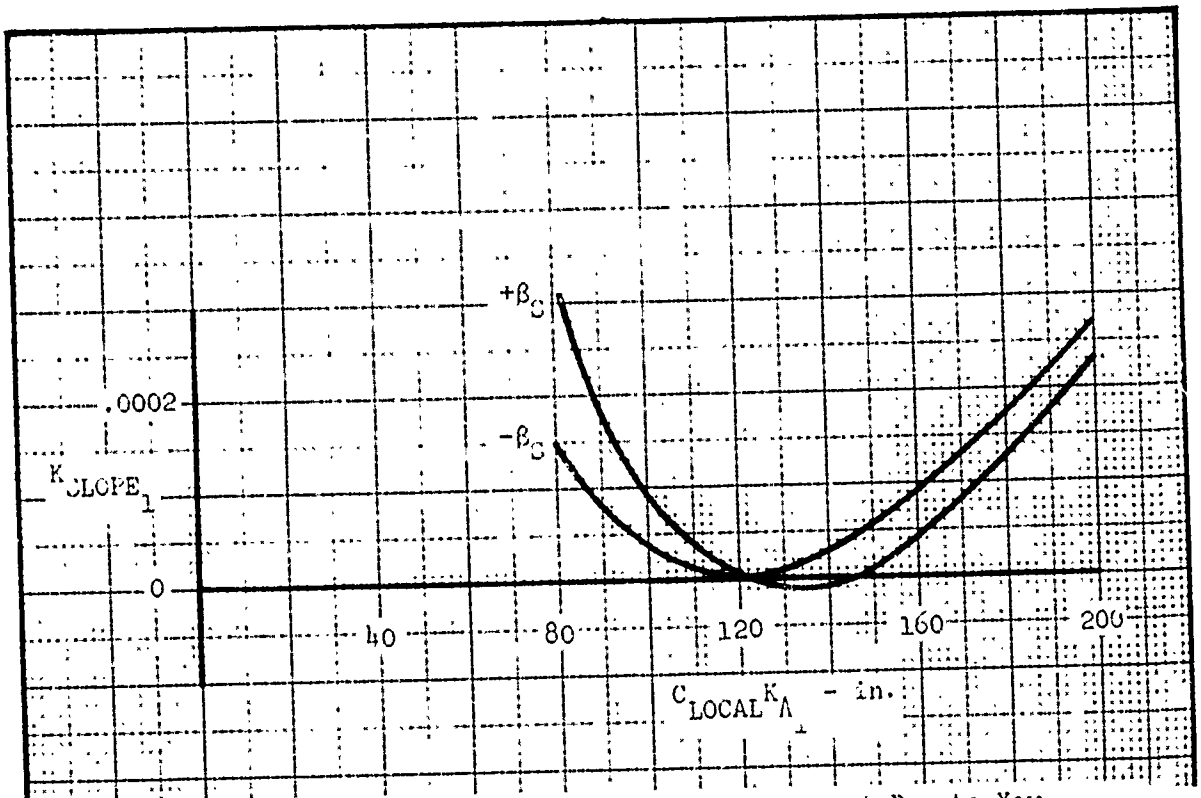

Figure 107. Incremental Yawing Moment Intercept Due to Yaw - K_{SLOPE} for Mach Break 1

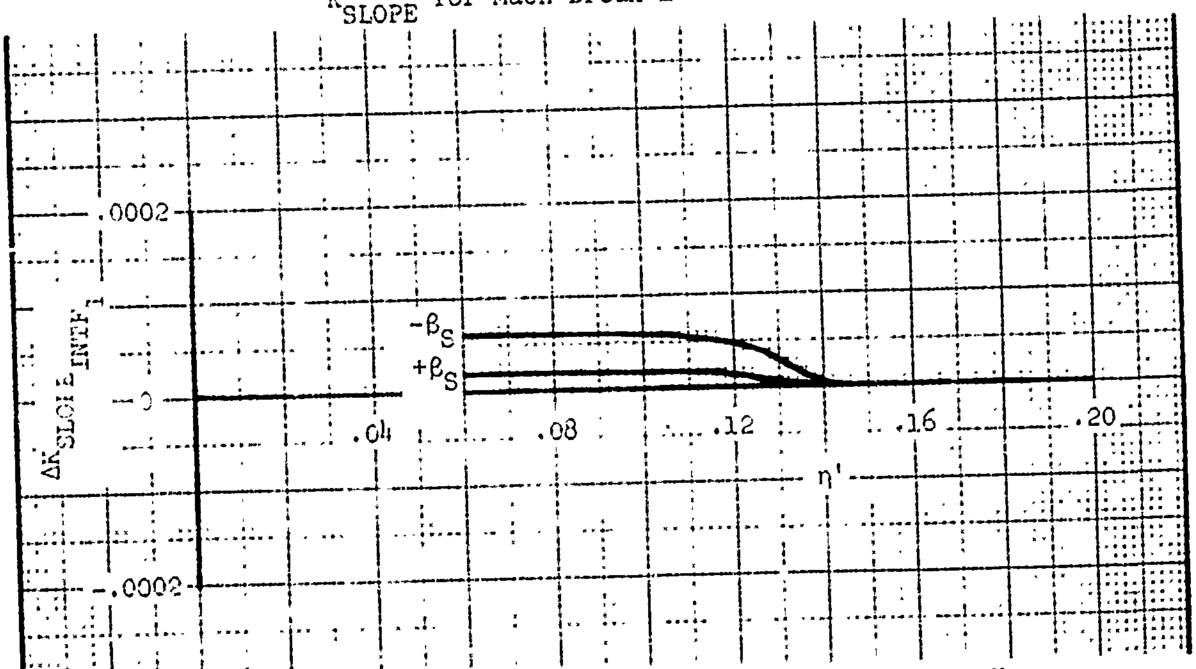

Figure 108. Incremental Yawing Moment Intercept Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

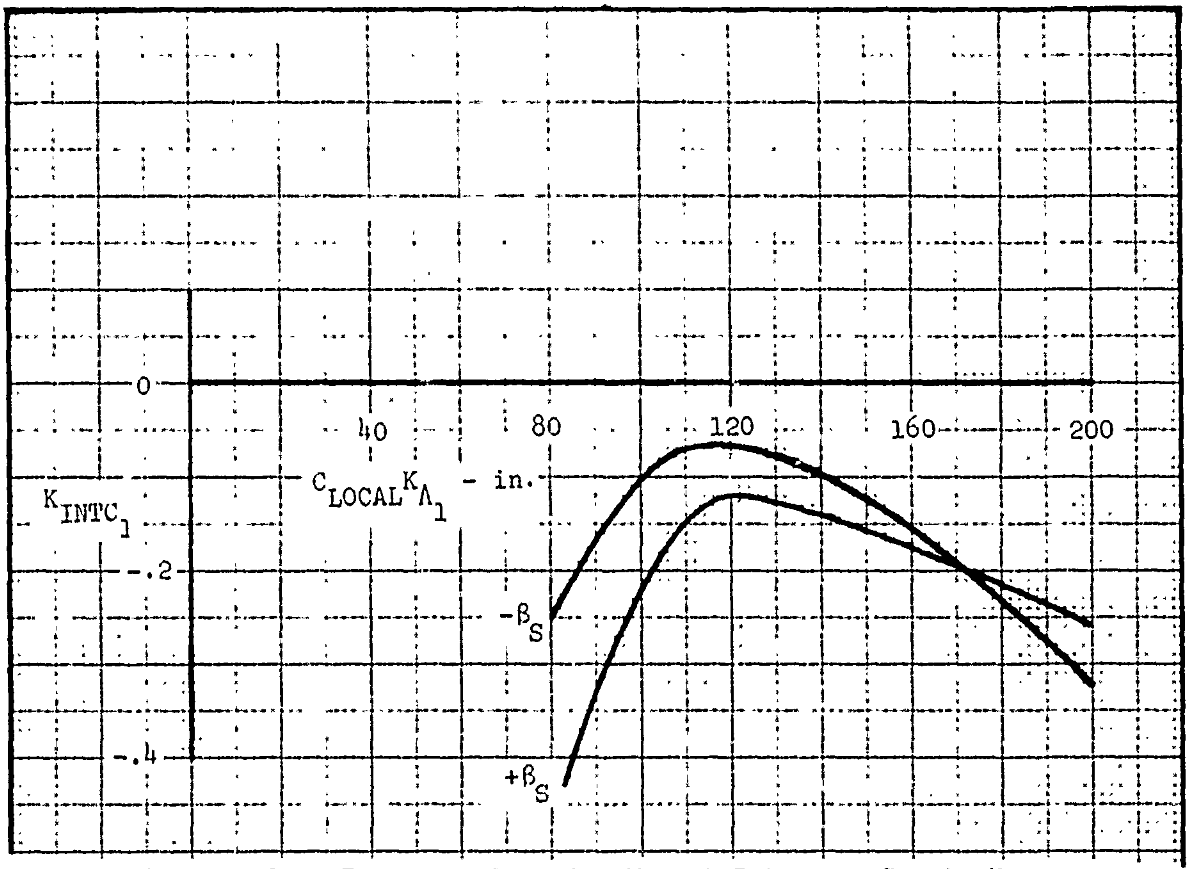

Figure 109. Incremental Yawing Moment Intercept Due to Yaw - K_{INTC} for Mach Break 1

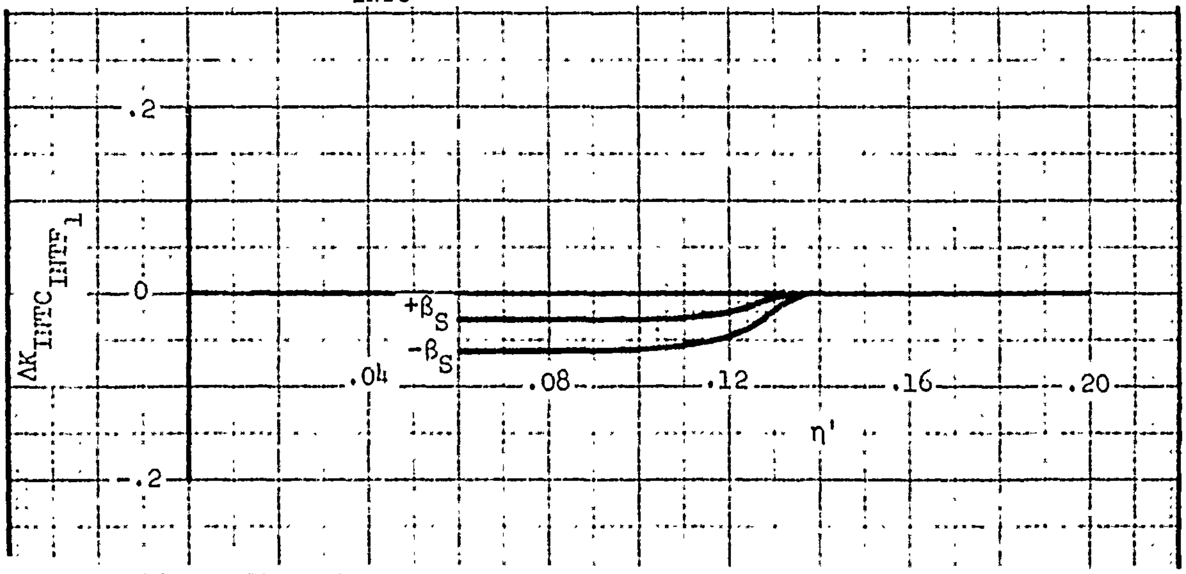

Figure 110. Incremental Yawing Moment Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

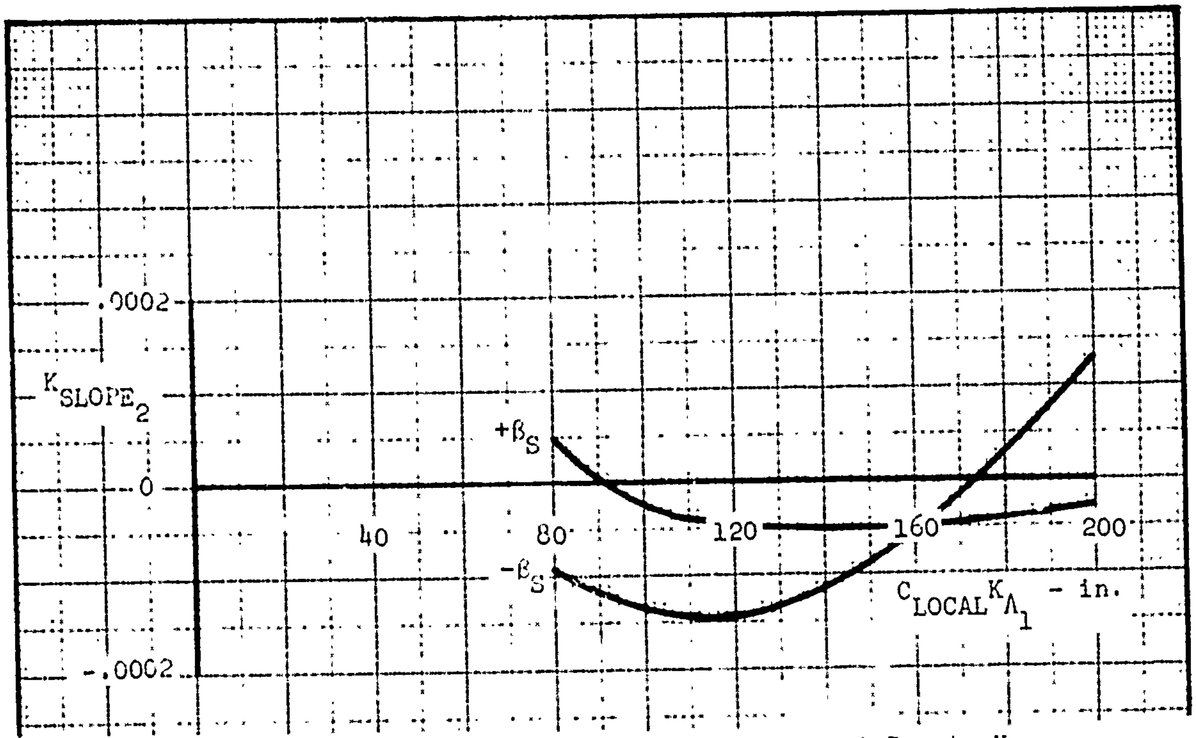

Figure 111. Incremental Yawing Moment Intercept Due to Yaw - K_{SLOPE} for Mach Break 2

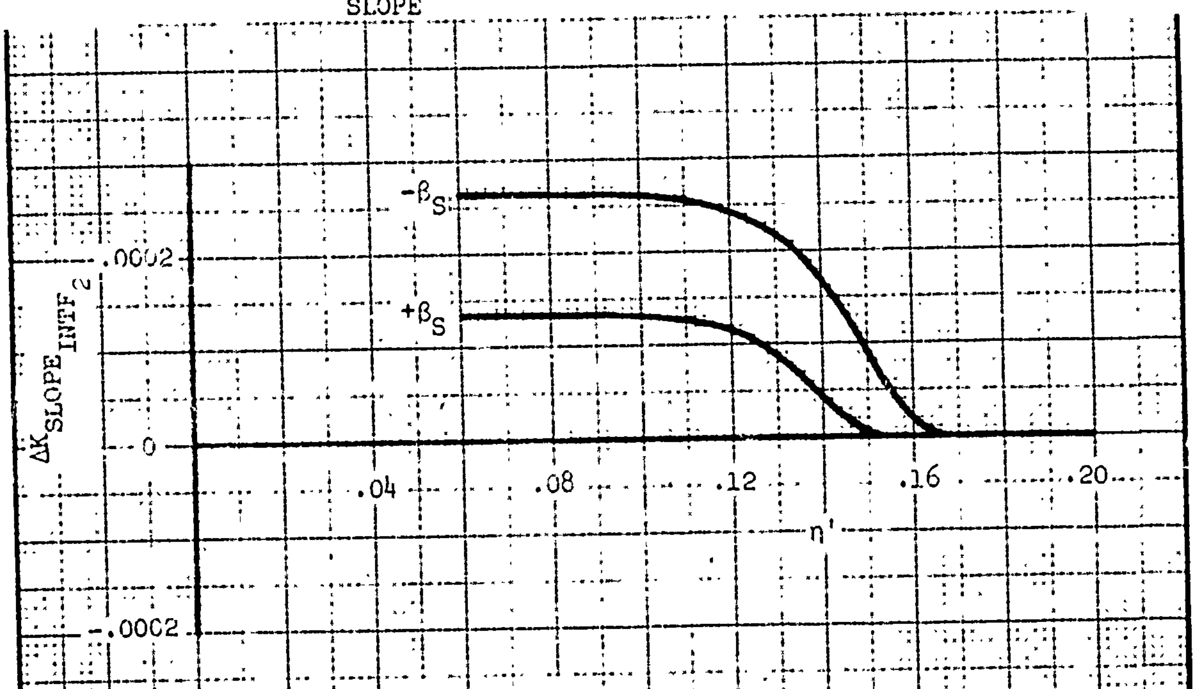

Figure 112. Incremental Yswing Moment Intercept Due to Yaw - K_{SLOPE_2} Fuselage Interference Correction

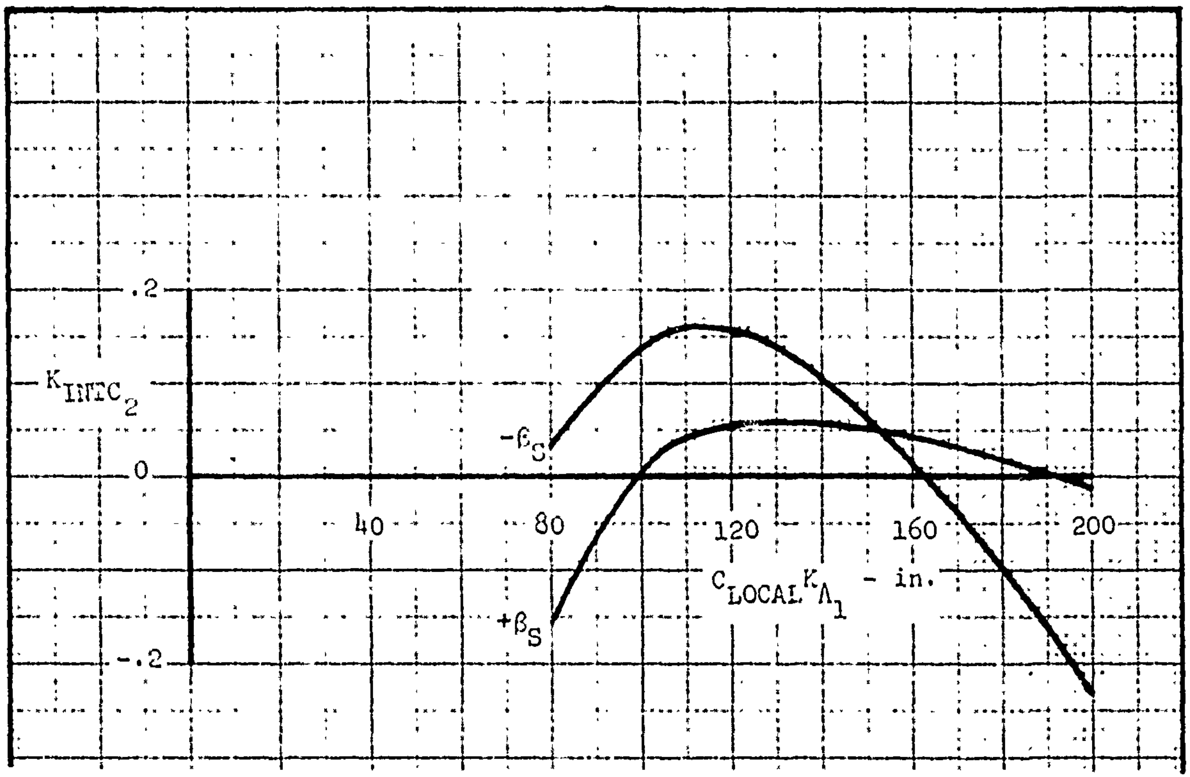

Figure 113. Incremental Yawing Moment Intercept Due to Yaw - K_{INTC} for Mach Break 2

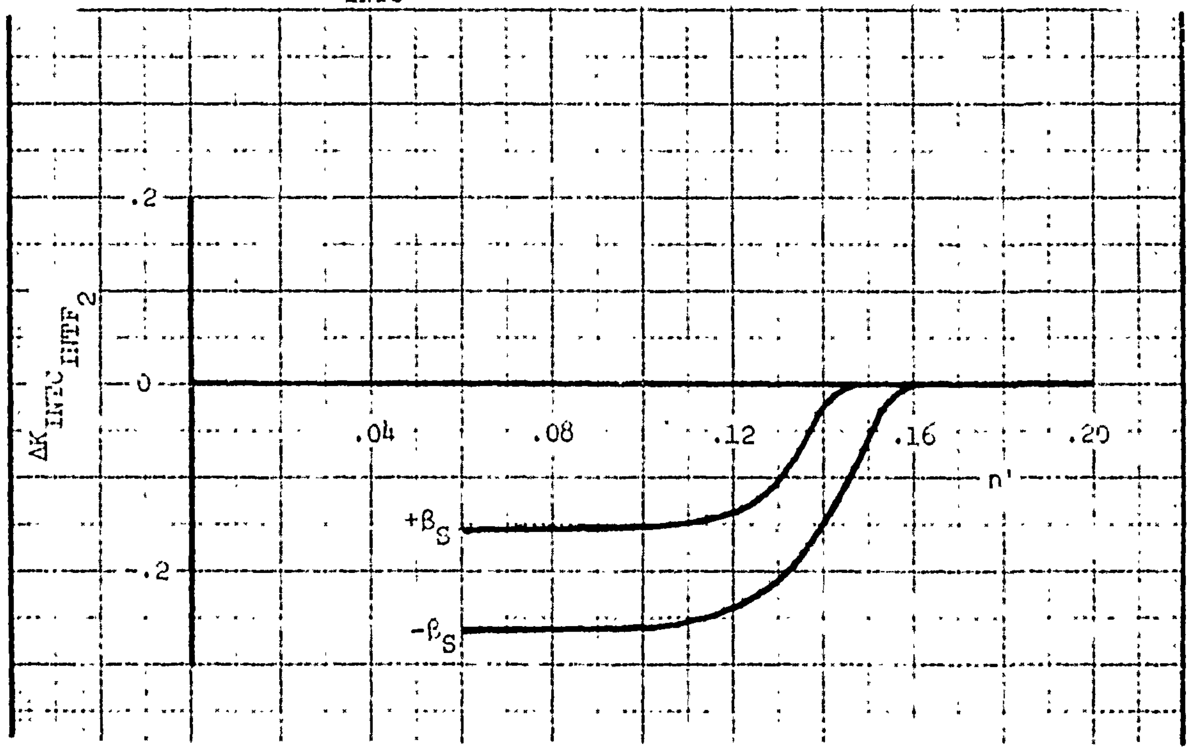

Figure 114. Incremental Yawing Moment Intercept Due to Yaw - K_{INTC_2} Fuselage Interference Correction

3.2.3 Increment - Adjacent Store Interference

The discussion of incremental yawing moment due to adjacent store interference is analogous to that of side force found in Subsection 3.1.3.

3.2.3.1 Slope Prediction

The equation for predicting the incremental yawing moment slope is given below.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha_{INTF}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right) S_{REF}d$$

where:

K_{SLOPE_1} - Variation of ΔC_{n_α} with $\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$, $\frac{1}{deg}$, Figure 115.

d_{INTF} - Effective diameter of the interfering store, ft., defined in Subsection 3.1.3.

x_{INTF} - Nose overlap distance, in., defined in Subsection 3.1.3.

d - Subject store diameter, ft.

y_{INTF} - Store separation distance, in., defined in Subsection 3.1.3.

S_{REF} - Subject store reference area, $\frac{\pi d^2}{4}$, ft^2

A numerical example illustrating the use of the above equation is found in Subsection 3.1.3.1.

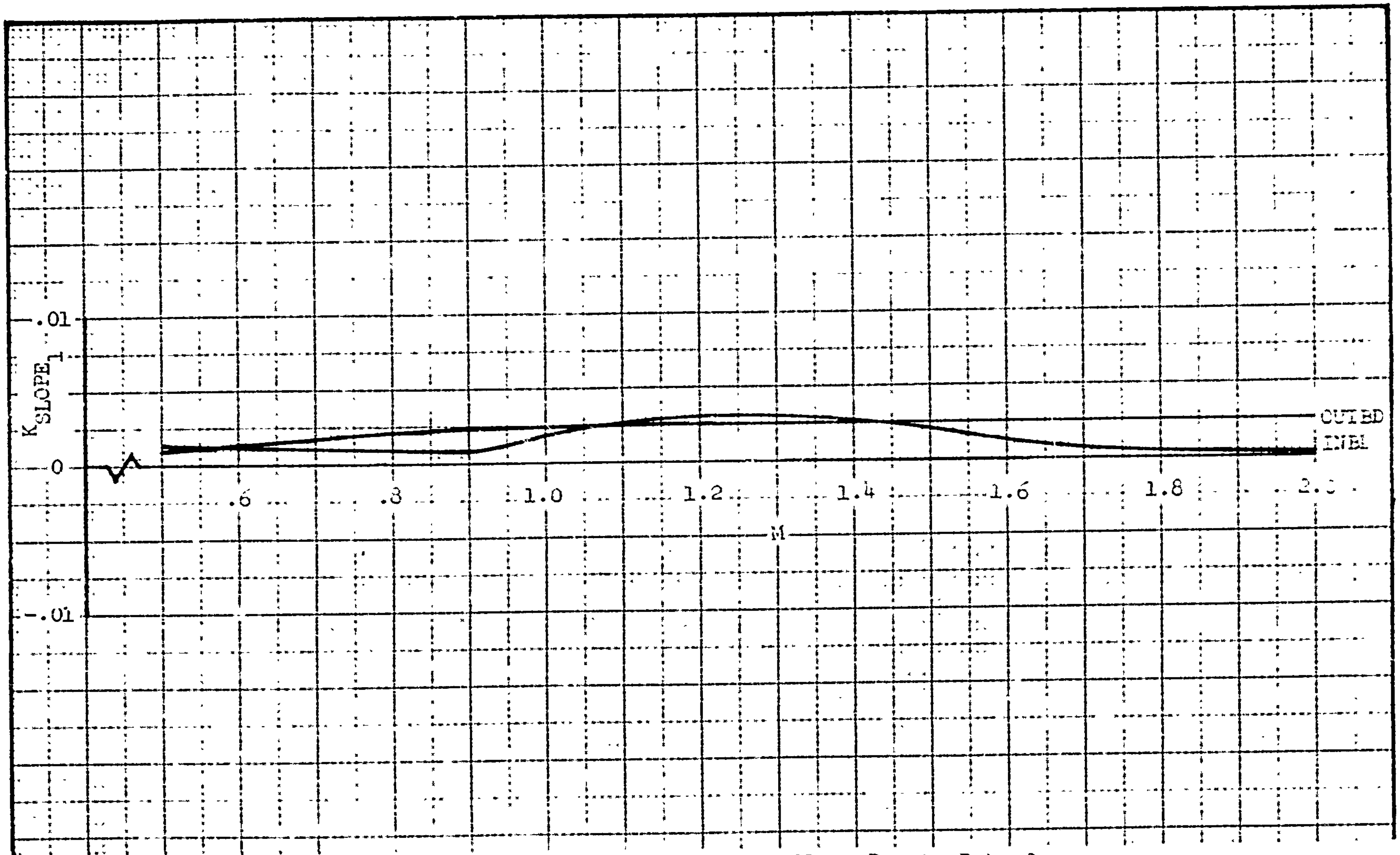

Figure 115. Incremental Yawing Moment Slope Due to Interference-K_{SLOPE_1} for Inboard and Outboard Interference

3.2.3.2 Intercept Prediction

The equation to predict incremental yawing moment intercept, $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$, for M = 0.5 is given below.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}} = (K_{SLOPE_1} + \Delta K_{SLOPE_\eta})\left(\frac{d_{INTF}(200-\ell_{LE})}{d\cdot y_{INTF}}\right)K_{\Lambda_1}\cdot d$$

where:

K_{SLOPE_1} - Variation of $\Delta C_{n_{\alpha=0}} \cdot S_{REF}$ with $\frac{d_{INTF}(200-\ell_{LE})}{d\cdot y_{INTF}}$, ft^2, Figure 116.

ΔK_{SLOPE_η} - Incremental change in $\Delta C_{n_{\alpha=0}} \cdot S_{REF}$ with spanwise store location, ft^2, Figure 117.

d_{INTF} - Effective diameter of the interfering store, ft, defined in Subsection 3.1.3.

d - Subject store diameter, ft.

ℓ_{LE} - Distance from subject store nose to local wing leading edge as measured in the wing plan view, in.

y_{INTF} - Store separation distance, in., defined in Subsection 3.1.3.

K_{Λ_1} - $\frac{\sin\Lambda}{\sin 45°}$, Aircraft wing sweep correction factor where Λ is equal to the quarter-chord sweep angle of the subject wing.

Example: Calculate $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$ for a 300-gallon tank on A-7 center pylon with M117 on inboard pylon at M=0.5.

Required for Computation:

d = 2.2 ft

$d_{INTF} = 1.33$ ft

$y_{INTF} = 14.7$ in.

$\ell_{LE} = 75.1$ in.

$K_{\Lambda_1} = .811$

$C_{LOCAL} = 127.6$ in.

$K_{SLOPE_1} = .08$ - Figure 116

$\Delta K_{SLOPE_\eta} = .09$- Figure 117

substituting,

$$\Delta\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\ INTF}} = (.08 + .09)\left(\frac{1.33\ (200-75.1)}{2.2(14.7)}\right)(2.2)(.811)$$

$$= 1.557\ ft^3$$

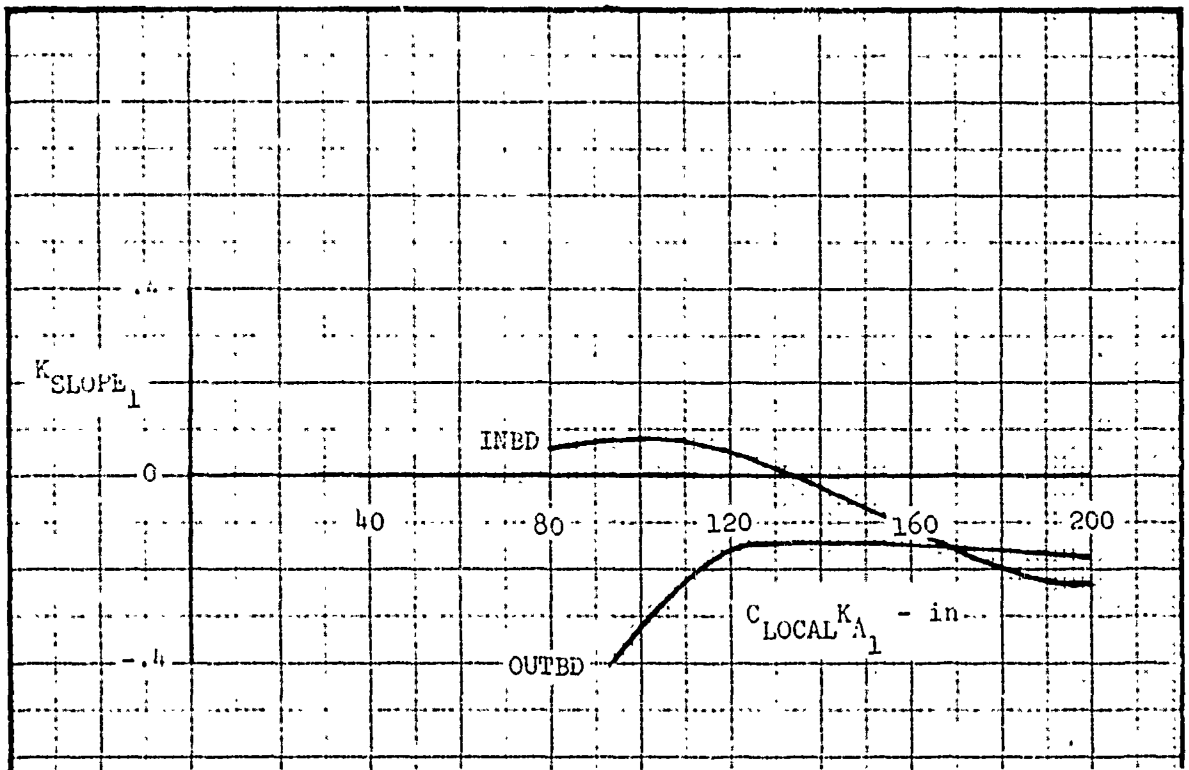

Figure 116. Incremental Yawing Moment Intercept Due to Interference - K_{SLOPE_1} for Inboard and Outboard Adjacent Store Interference

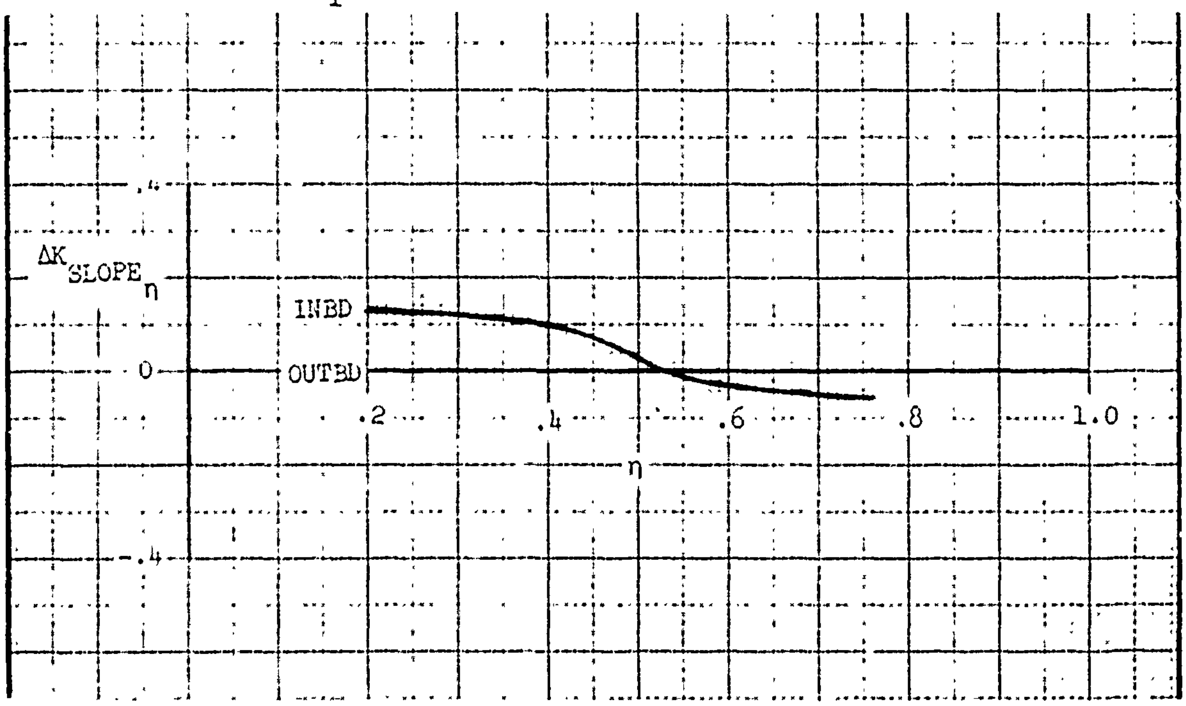

Figure 117. Incremental Yawing Moment Intercept Due to Interference - K_{SLOPE_1} Spanwise Correction

3.2.3.3 Intercept Mach Number Correction

The equation for predicting the incremental yawing moment intercept, $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$, between M = 0.5 and M = 2.0 is given by the following equation:

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=x}}} = \Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=0.5}}} + \Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=x}}}$$

where:

$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=0.5}}}$ - Incremental yawing moment intercept value at M=0.5.

$\Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=x}}}$ - Incremental change with Mach number from the incremental yawing moment intercept value at M=0.5.

A generalized curve depicting the incremental yawing moment intercept variation with Mach number is given by Figure 118.

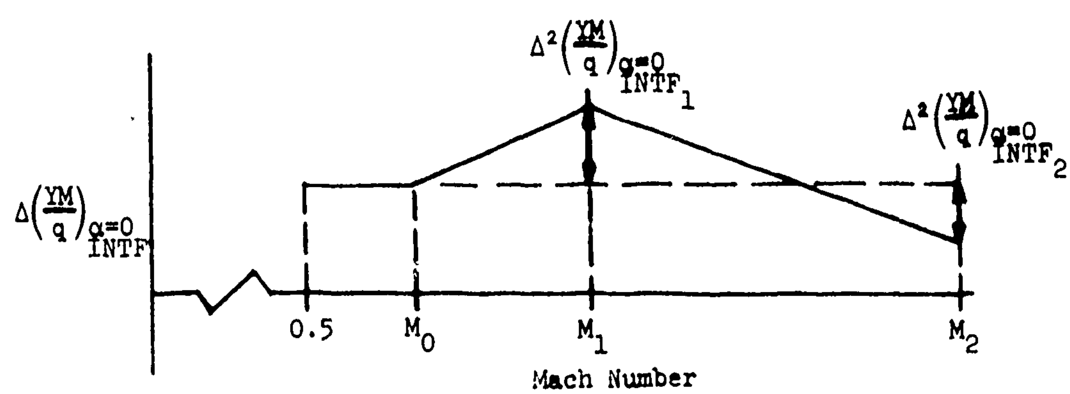

Figure 118. Incremental Yawing Moment Intercept Due to Interference - Generalized Mach Number Variation

The incremental intercept variation with Mach number has been approximated by a series of linear segments with break points at Mach numbers defined by M_0, M_1 and M_2. The variation of the Mach

break points is presented in Figures 119 and 120 as a function of C_{LOCAL} K_{Λ_1}. M_0 is the Mach number where the incremental intercept initially deviates from the value predicted at M=0.5. Equations have been developed to predict the incremental changes from that predicted at M = 0.5 at each of the remaining Mach break points. These equations are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\ INTF_1}} = [K_{SLOPE_1}\left(\frac{d_{INTF}x_{INTF}}{d}\right) + K_{INTC_1}]S_{REF}K_{\Lambda_1} \cdot d$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^3}$, Figure 121.

$\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1, in^2.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{in.}$, Figure 122.

$\frac{d_{INTF}x_{INTF}}{d}$ - Defined in Subsection 3.1.3, in.

$$K_{INTC_1} = K_{SLOPE_3}\left(\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}\right) + K_{INTC_3}$$

and additionally,

K_{SLOPE_3} - Variation of K_{INTC_1} with $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2}$, Figure 123.

$\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}$ - Defined in Subsection 3.2.2.1, in^2.

K_{INTC_3} - Value of K_{INTC_1} when $\frac{\ell_{LE}ADJ.NOSE\ SPA}{L} = 0$, Figure 124.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

K_{Λ_1} - $\frac{\sin \Lambda}{\sin 45°}$, Aircraft wing sweep correction factor, where Λ equals the quarter-chord sweep angle of the subject wing.

Break 2 (M_2):

$$\Delta^{\beta}\left(\frac{YM}{q}\right)_{\substack{\alpha=0\\ INTF_2}} = [K_{SLOPE_4}\left(\frac{d_{INTF}x_{INTF}}{d}\right) + K_{INTC_4}]S_{REF}K_{\Lambda_1} d$$

where:

$$K_{SLOPE_4} = K_{SLOPE_5}\left(\frac{\ell_{LE}ADJ.NOSE\ SPA}{L}\right) + K_{INTC_5}$$

and additionally,

K_{SLOPE_5} - Variation of K_{SLOPE_4} with $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^3}$, Figure 125.

K_{INTC_5} - Value of K_{SLOPE_4} when $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L} = 0$, $\frac{1}{in.}$, Figure 126.

$$K_{INTC_4} = K_{SLOPE_6}\left(\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}\right) + K_{INTC_6}$$

and additionally,

K_{SLOPE_6} - Variation of K_{INTC_4} with $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L}$, $\frac{1}{in^2}$, Figure 127.

K_{INTC_6} - Value of K_{INTC_4} when $\frac{\ell_{LE} ADJ.NOSE\ SPA}{L} = 0$, Figure 128.

To compute $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$ at M = x, first determine from Figure 119 or 120 between which Mach number break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Then, compute $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$ at M = x from the following expression.

$$\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=x}}} = \Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M=0.5}}} + \Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M_{LOW}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)$$

$$\left[\Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M_{HI}}}} - \Delta^2\left(\frac{YM}{q}\right)_{\alpha=0_{INTF_{M_{LOW}}}}\right]$$

If x > 1.6, then $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$ at M = x is equal to the value obtained at M = 1.6.

If $x \leq M_0$ then $\Delta\left(\frac{YM}{q}\right)_{\alpha=0_{INTF}}$ at M = x is equal to the value obtained at M = 0.5 from Subsection 3.2.3.2 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 3.2.2.2.

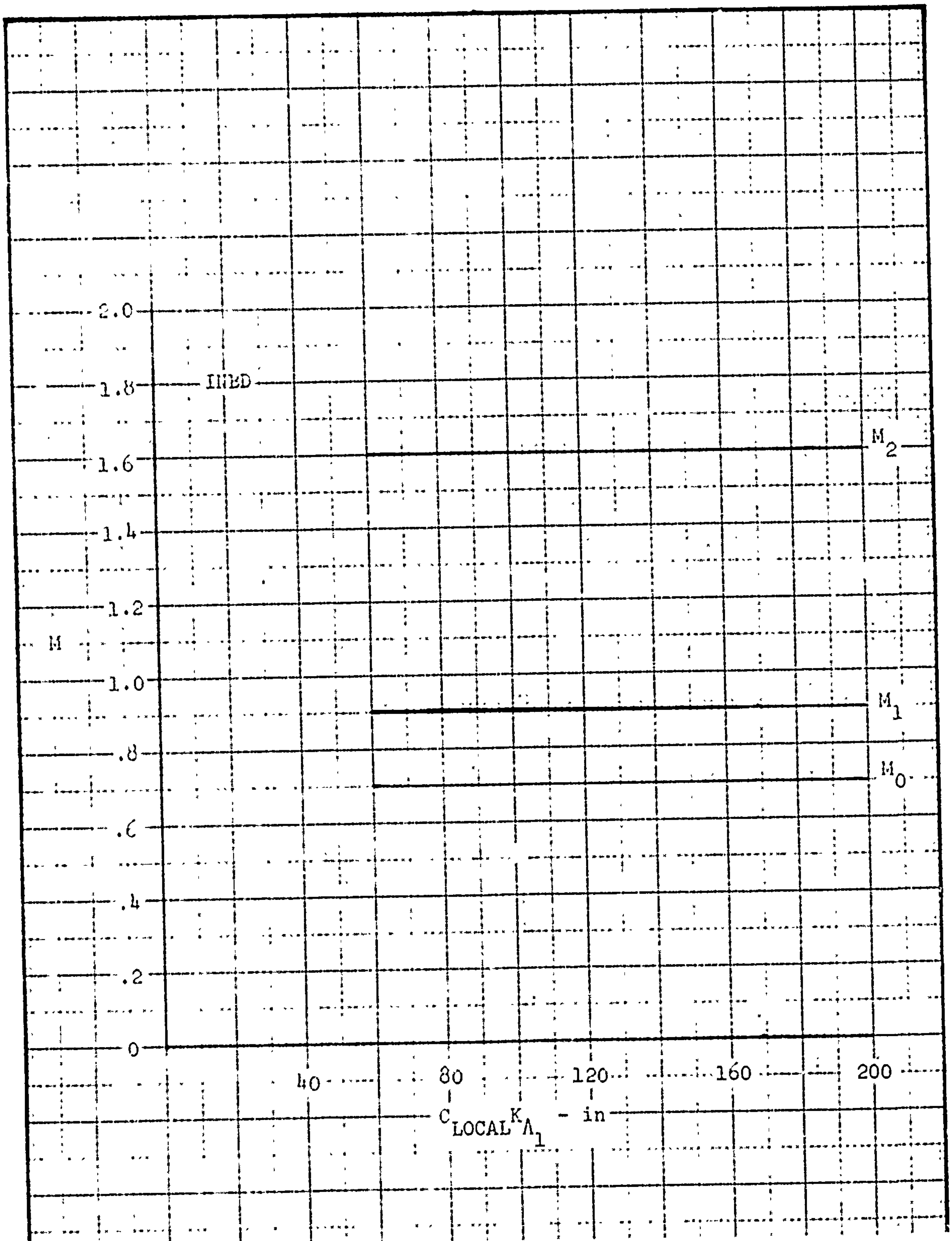

Figure 119. Incremental Yawing Moment Intercept Due to Interference - Mach Number Break Points for Inboard Interference

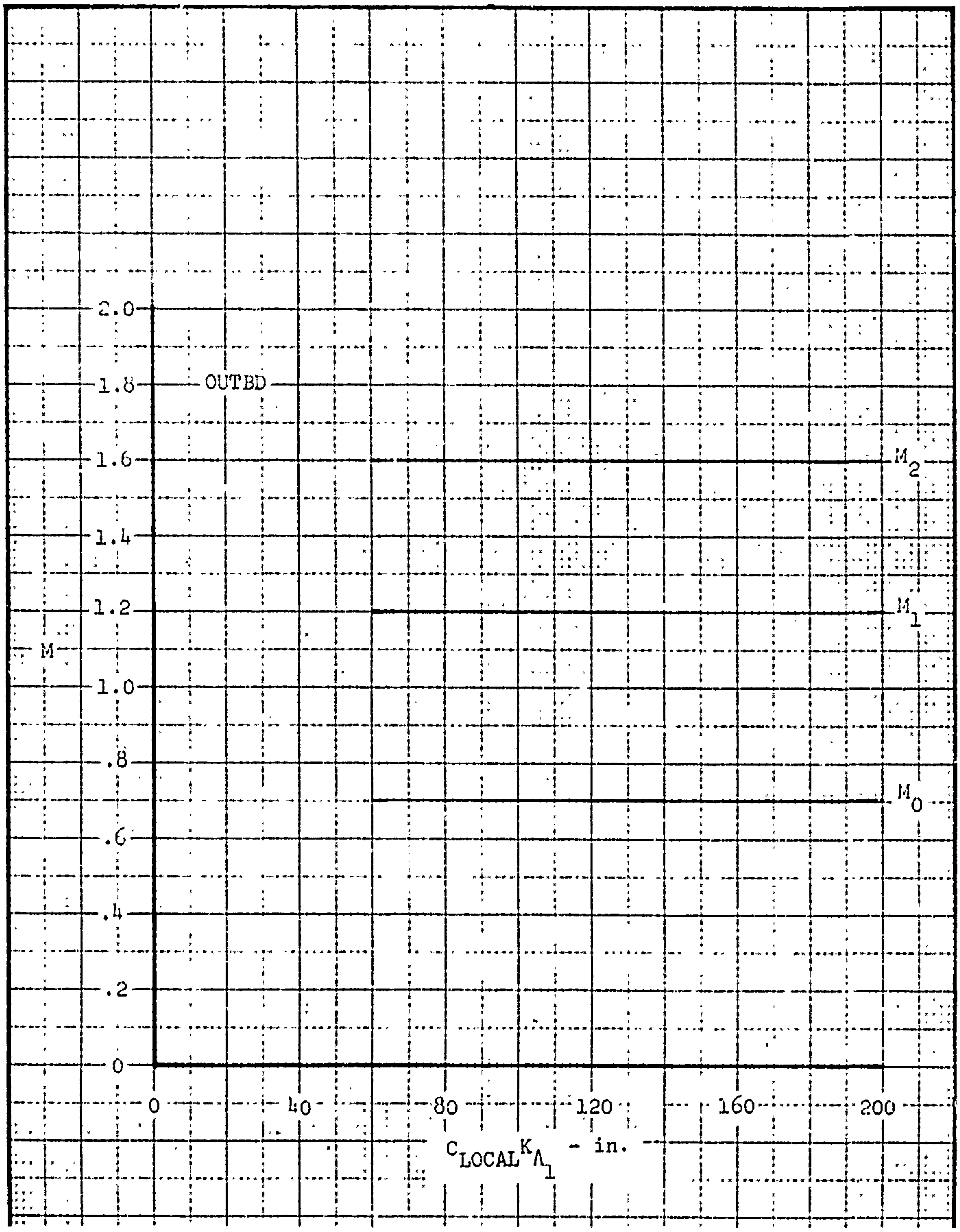

Figure 120. Incremental Yawing Moment Intercept Due to Interference - Mach Number Break Points for Outboard Interference

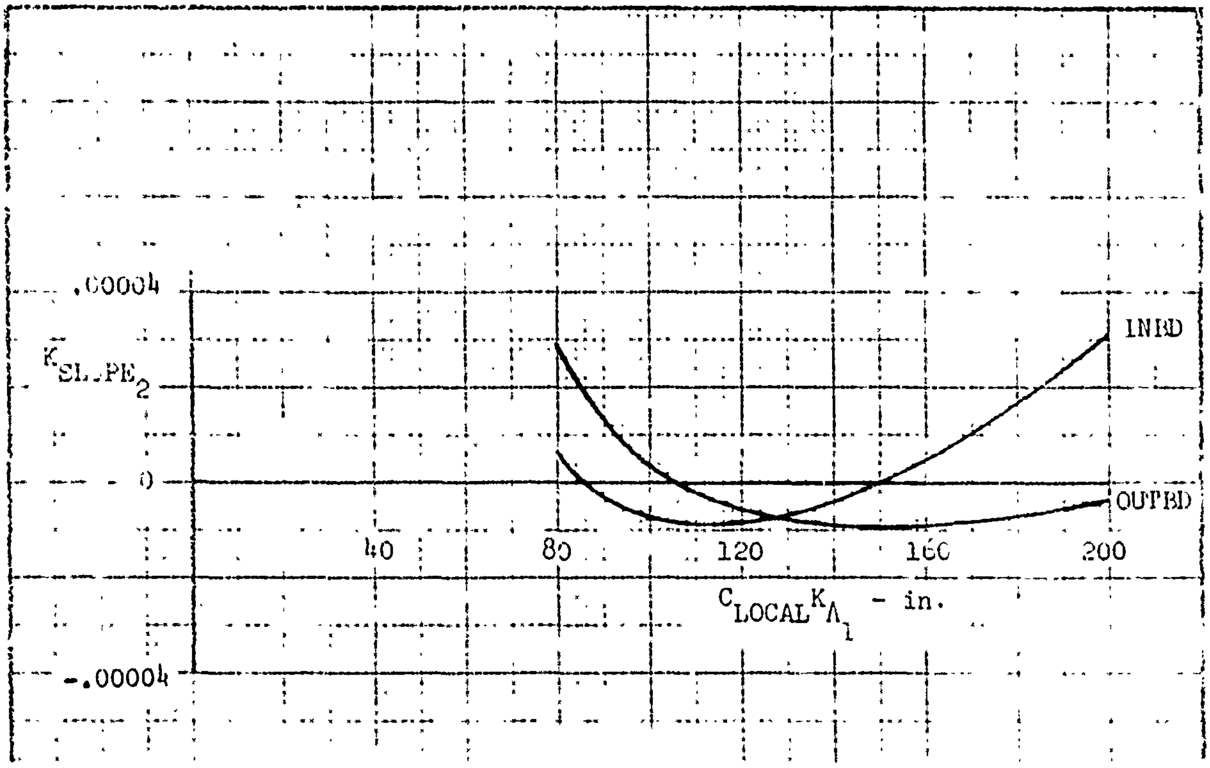

Figure 121. Incremental Yawing Moment Intercept Due to Interference - K_{SLOPE_2} for Inboard and Outboard Interference

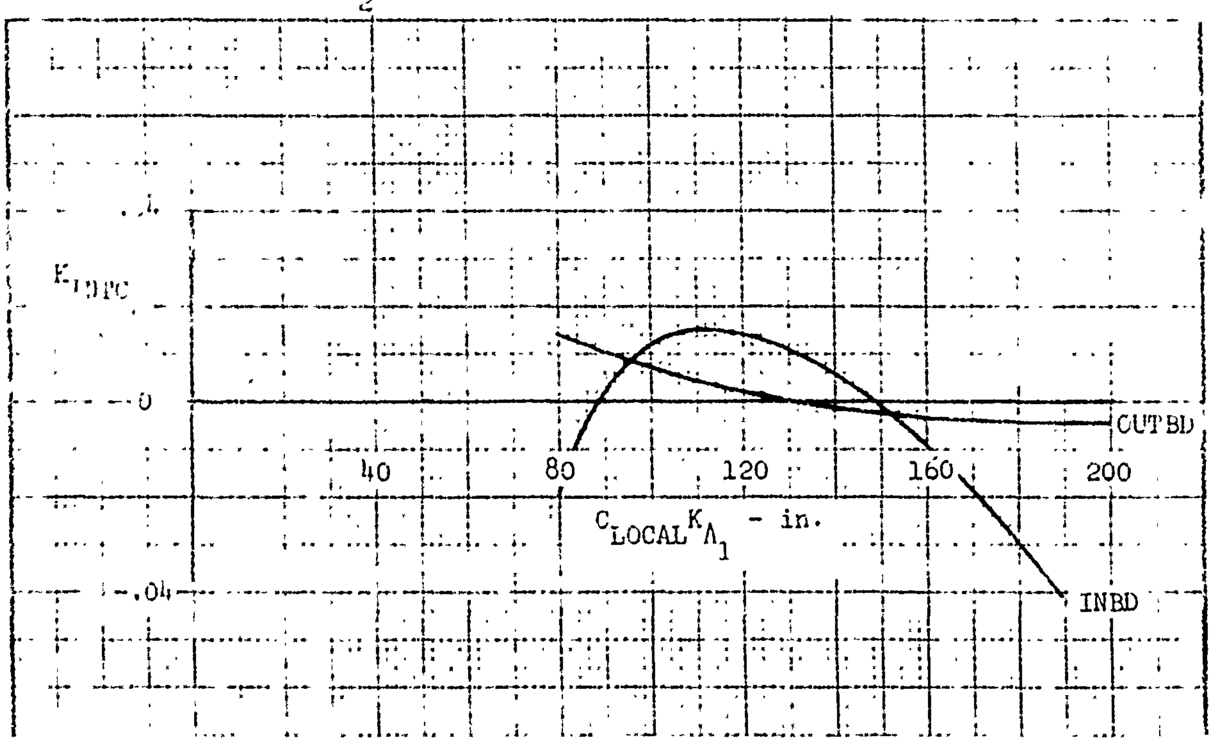

Figure 122. Incremental Yawing Moment Intercept Due to Interference - K_{INTC_2} for Inboard and Outboard Interference

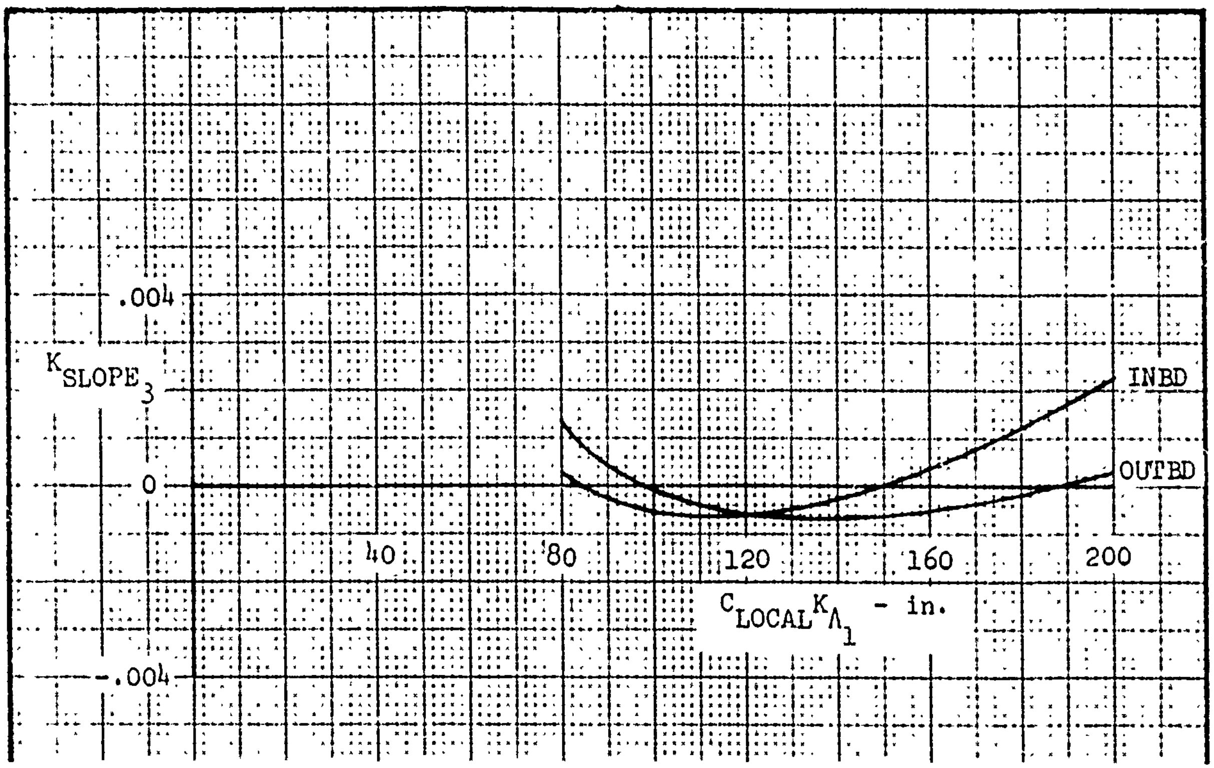

Figure 123. Incremental Yawing Moment Intercept Due to Interference - K_{SLOPE_3} for Inboard and Outboard Interference

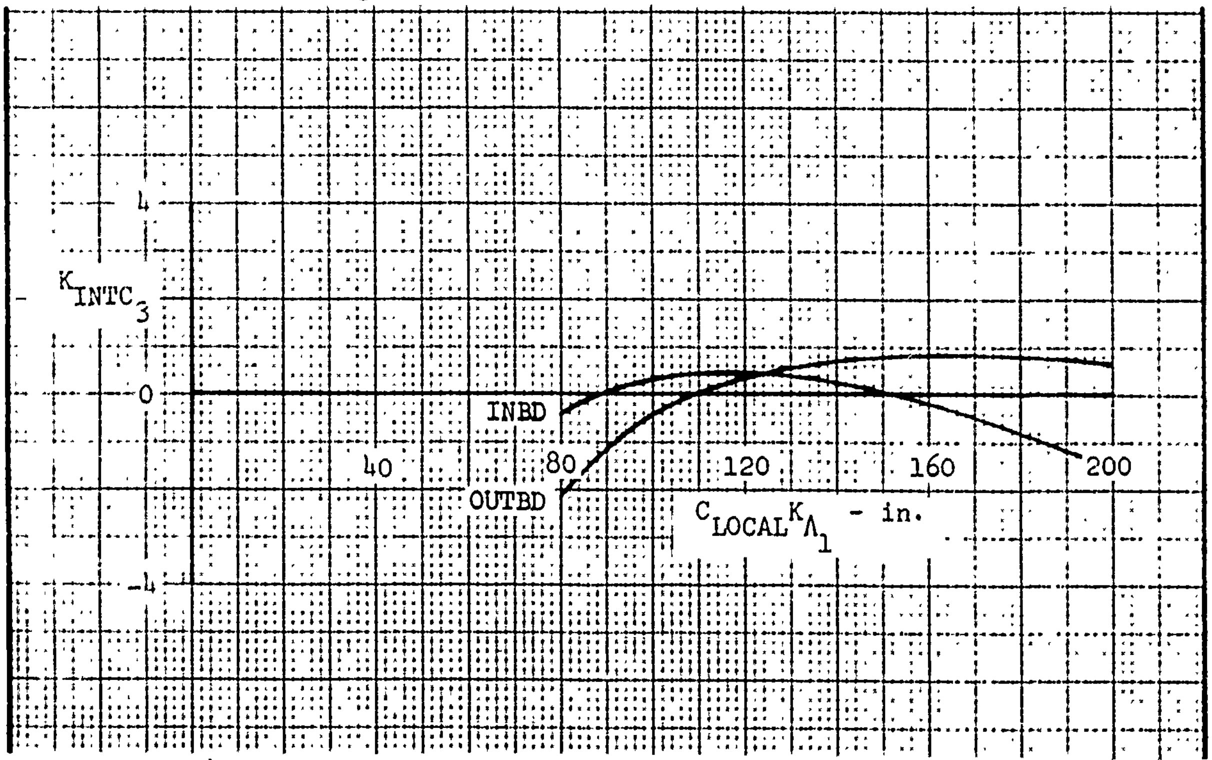

Figure 124. Incremental Yawing Moment Intercept Due to Interference - K_{INTC_3} for Inboard and Outboard Interference

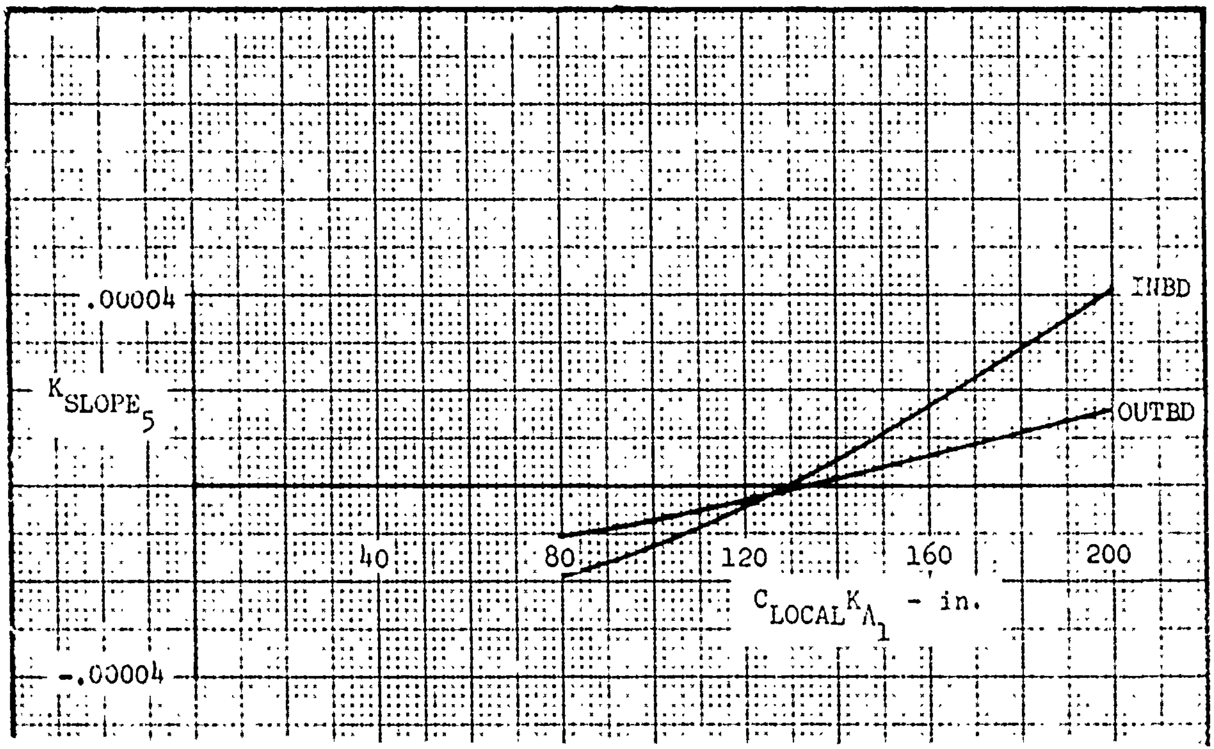

Figure 125. Incremental Yawing Moment Intercept Due to Interference - K_{SLOPE_5} for Inboard and Outboard Interference

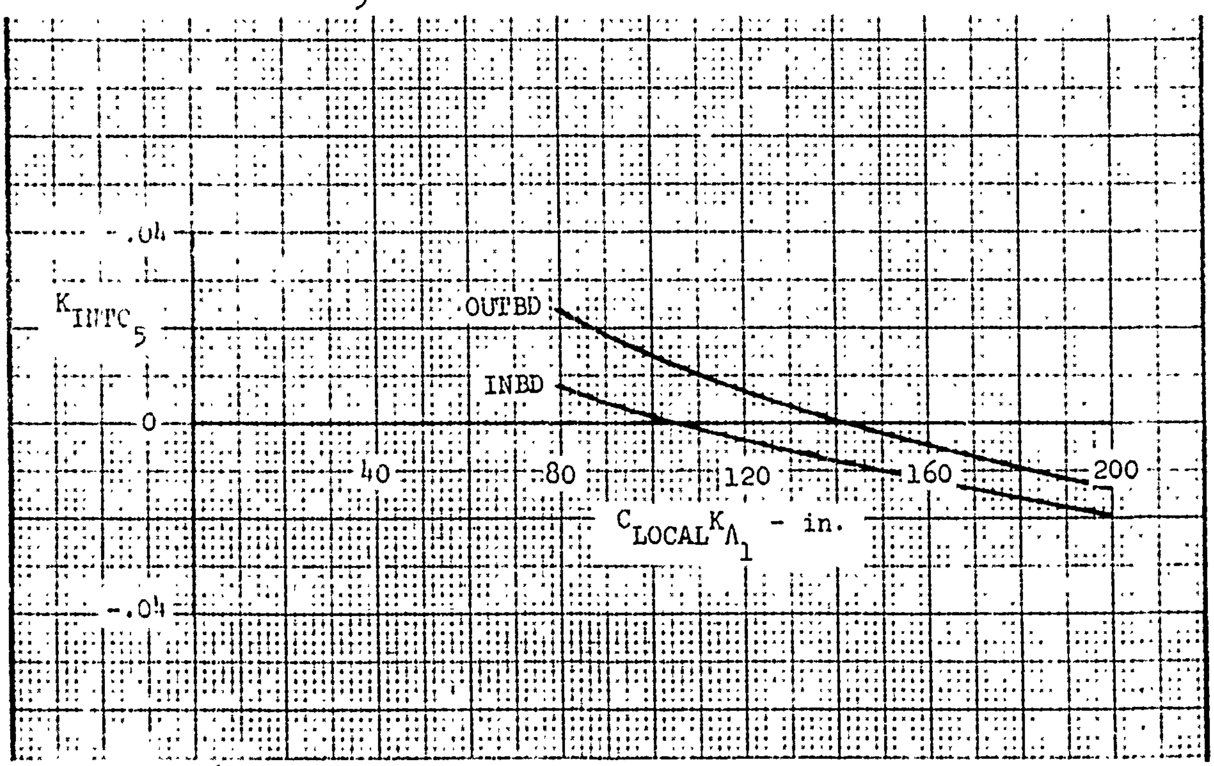

Figure 126. Incremental Yawing Moment Intercept Due to Interference - K_{INTC_5} for Inboard and Outboard Interference

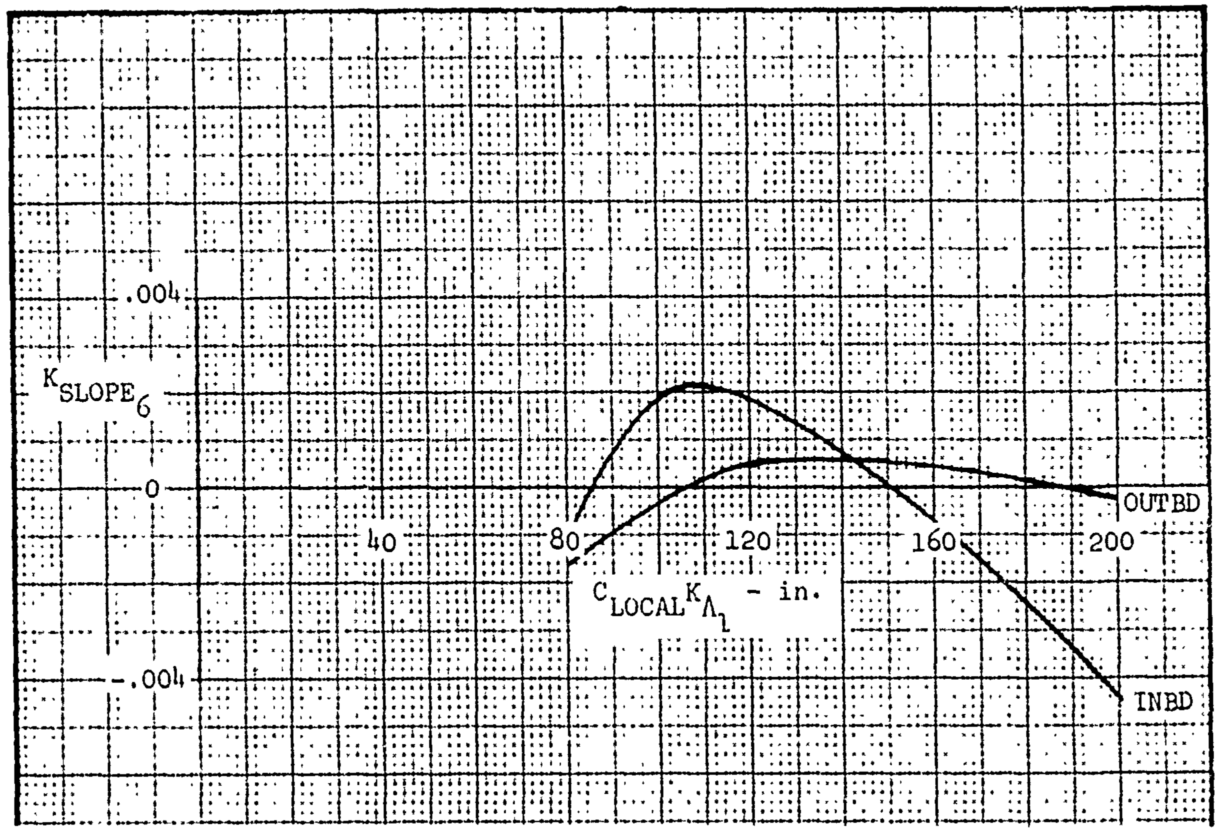

Figure 127. Incremental Yawing Moment Intercept Due to Interference - K_{SLOPE_6} for Inboard and Outboard Interference

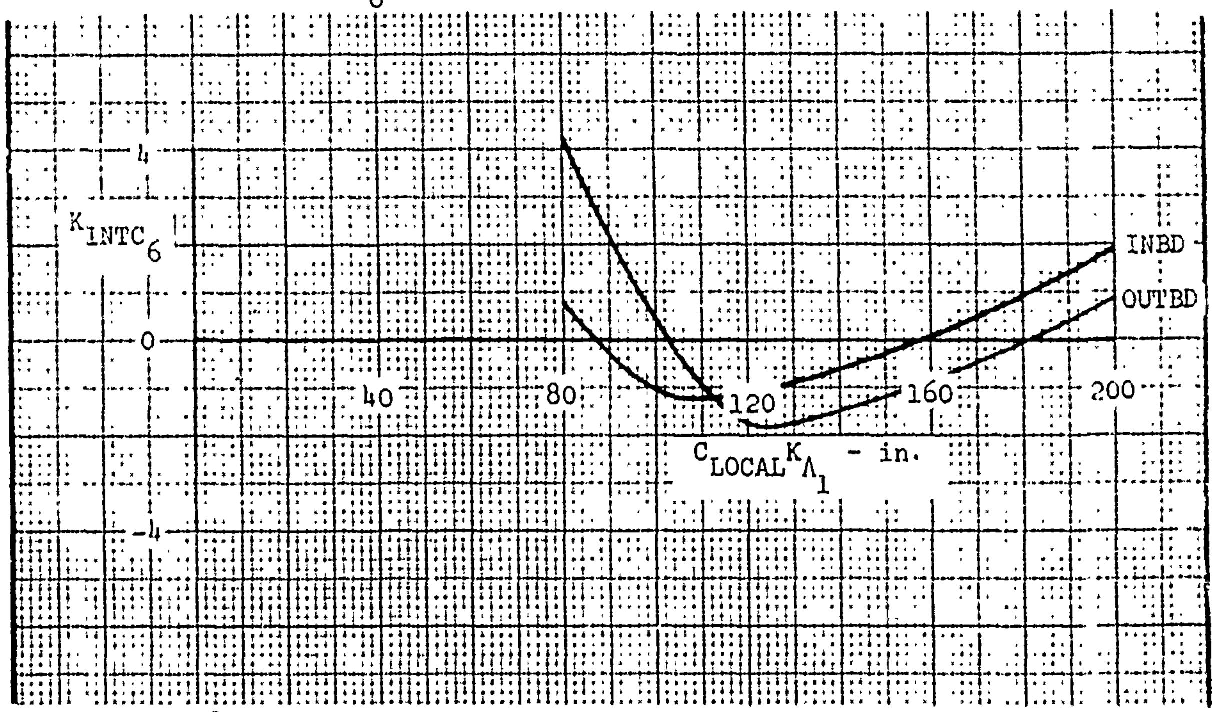

Figure 128. Incremental Yawing Moment Intercept Due to Interference - K_{INTC_6} for Inboard and Outboard Interference

3.3 NORMAL FORCE

3.3.1 Basic Airload

The normal force acting on an installed store is influenced to a large extent by a wing/store interaction not present in the lateral plane. This effect, which creates an up-load on the store body at low wing incidences, diminishes with angle of attack. A thorough discussion of this buoyancy effect is included in Reference 5.

3.3.1.1 Slope Prediction

The variation of captive store normal force with angle of attack is defined by the following relationship.

$$\left(\frac{NF}{q}\right)_{\alpha_{PRED}} = K_{\Lambda_2} K_{C_{NF}} \left(\frac{NF}{q}\right)_{\alpha_{ISO}} - \left(\frac{NF}{q}\right)_{\alpha_{BUOY}}$$

where:

$$\left(\frac{NF}{q}\right)_{\alpha_{BUOY}} = K_{INTC_1} + K_{SLOPE_1} VAR_1$$

and:

$$VAR_1 = K^2_{\Lambda_2} K_{INTF} K_{L/C} K_{C_{NF}} \left(\frac{NF}{q}\right)_{\alpha_{ISO}} AREA$$

$$AREA = \frac{(ADJ.\ PPA - (1-K_Z)\ (ADJ.\ PPA\ FWD.\ OF\ WING))}{d}$$

The parameters in the above equations are defined below.

$K_{\Lambda_2} = \frac{\cos\ \Lambda}{\cos\ 45^\circ}$ - Aircraft wing sweep correction factor, where Λ is the sweep angle of the quarter-chord.

$K_C \left(\frac{NF}{q}\right)_{\alpha_{ISO}}$ - Initial normal force slope prediction, $\frac{ft^2}{deg}$, Subsection 2.3.2.

K_{INTC_1} $-\left(\frac{NF}{q}\right)_{\alpha_{BUOY}}$ at $VAR_1 = 0$, $\frac{ft.^2}{deg.}$, Figure 130.

K_{SLOPE_1} - Change in $\left(\frac{NF}{q}\right)_{\alpha_{BUOY}}$ with respect to VAR_1,

$$\frac{\partial\left(\frac{NF}{q}\right)_{\alpha_{BUOY}}}{\partial VAR_1}, \quad \frac{1}{\text{in.-deg.}}, \text{ Figure 129.}$$

K_{INTF} - Interference correction factor based on the distance from the edge of the store to the aircraft fuselage ($\eta' = \frac{y'}{Y}$) for high wing aircraft, Figure 132.

$K_{L/C}$ - Correction factor based on the ratio of store length to local chord, Figure 131.

K_z - Interference correction factor based on minimum clearance distance (L_{INLET}) between the installed store and the inlet for aircraft with side inlets, Figure 133.

ADJ. PPA - Adjusted plan projected area, in.^{2}, see Subsection 2.3.2.

AJD. PPA FWD. OF WING - That part of the adjusted plan projected area forward of the wing leading edge, in.^{2}, see Subsection 2.3.2.

d - Store diameter, in.

Example:

Compute $\left(\frac{NF}{q}\right)_{\alpha}$ for a 300-gallon tank on the A-7 center wing pylon.

Required for Computation:

$\eta = .418$

$C_{LOCAL} = 127.6$ in.

$$K_{\Lambda_2} = \frac{\cos 35^\circ}{\cos 45^\circ} = 1.158$$

$$\frac{L}{C_{LOCAL}} = 1.77$$

ADJ. PPA = 13,618. in ^{2}

ADJ. PPA Fwd. of Wing = 9897. in ^{2}

d = 26.5 in.

$$\eta' = \frac{y'}{Y} = .270$$

$$K_{C_{NF}} \left(\frac{NF}{q}\right)_{\alpha_{ISO}} = .714 \ \frac{ft^2}{deg}$$ - Subsection 2.3.2

$$K_{INTC_1} = .148 \ \frac{ft^2}{deg}$$ - Figure 130

$$K_{SLOPE_1} = .0043 \ \frac{1}{in.-deg.}$$ - Figure 129

$$K_{INTF} = 1.0$$ - Figure 132

$$K_{L/C} = 1.28$$ - Figure 131

$$K_z = N.A.$$

$$\left(\frac{NF}{q}\right)_{\alpha_{PRED}} = (1.158)(.714) - [(.148) + (.0043)(1.158)^2(1.0)(1.28)(.714)(\frac{13618-9897}{26.5})]$$

$$\left(\frac{NF}{q}\right)_{\alpha_{PRED}} = -.061 \ \frac{ft^2}{deg}$$

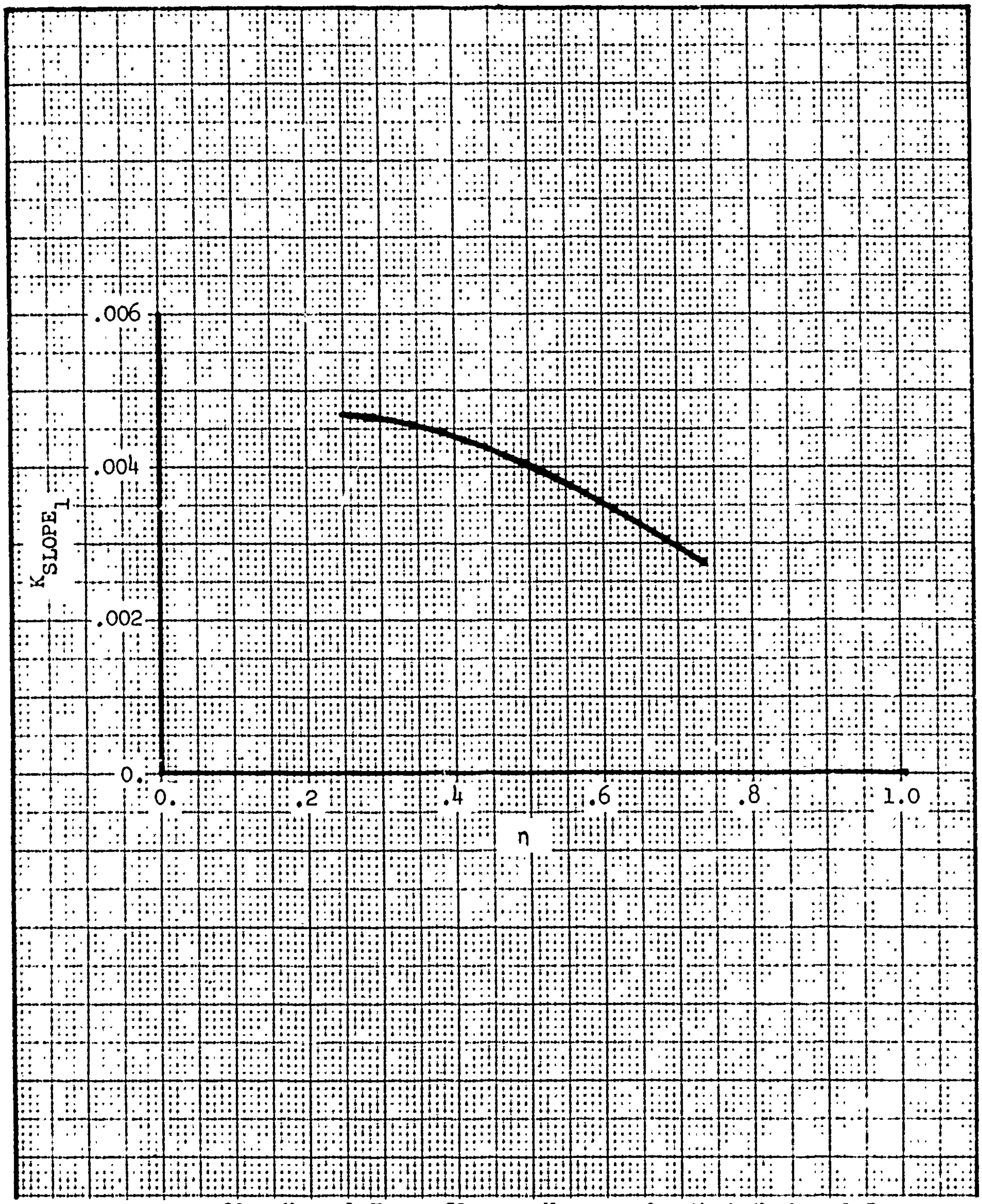

Figure 129. Normal Force Slope - K_{SLOPE_1} for Mach Number 0.5

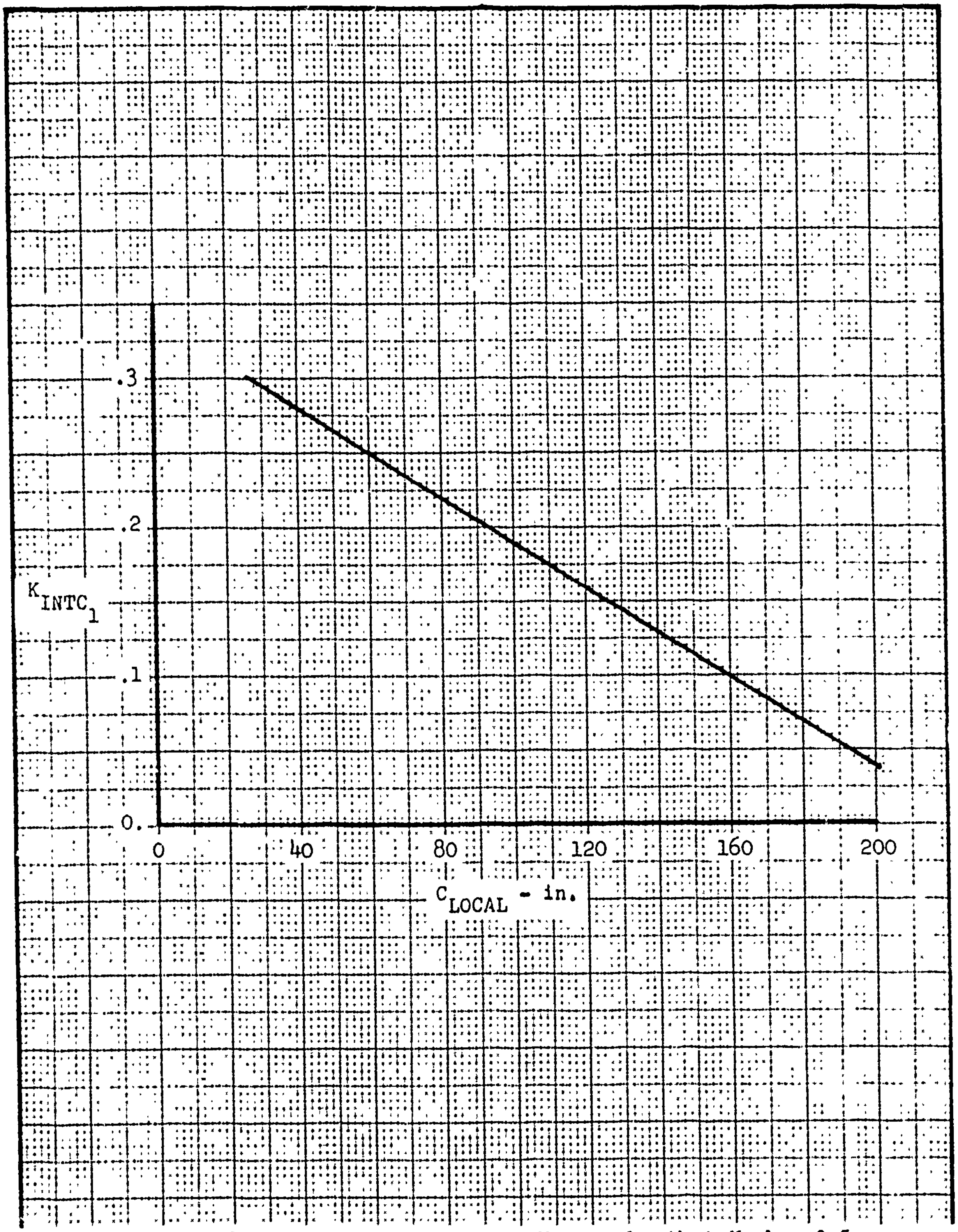

Figure 130. Normal Force Slope - K_{INTC_1} for Mach Number 0.5

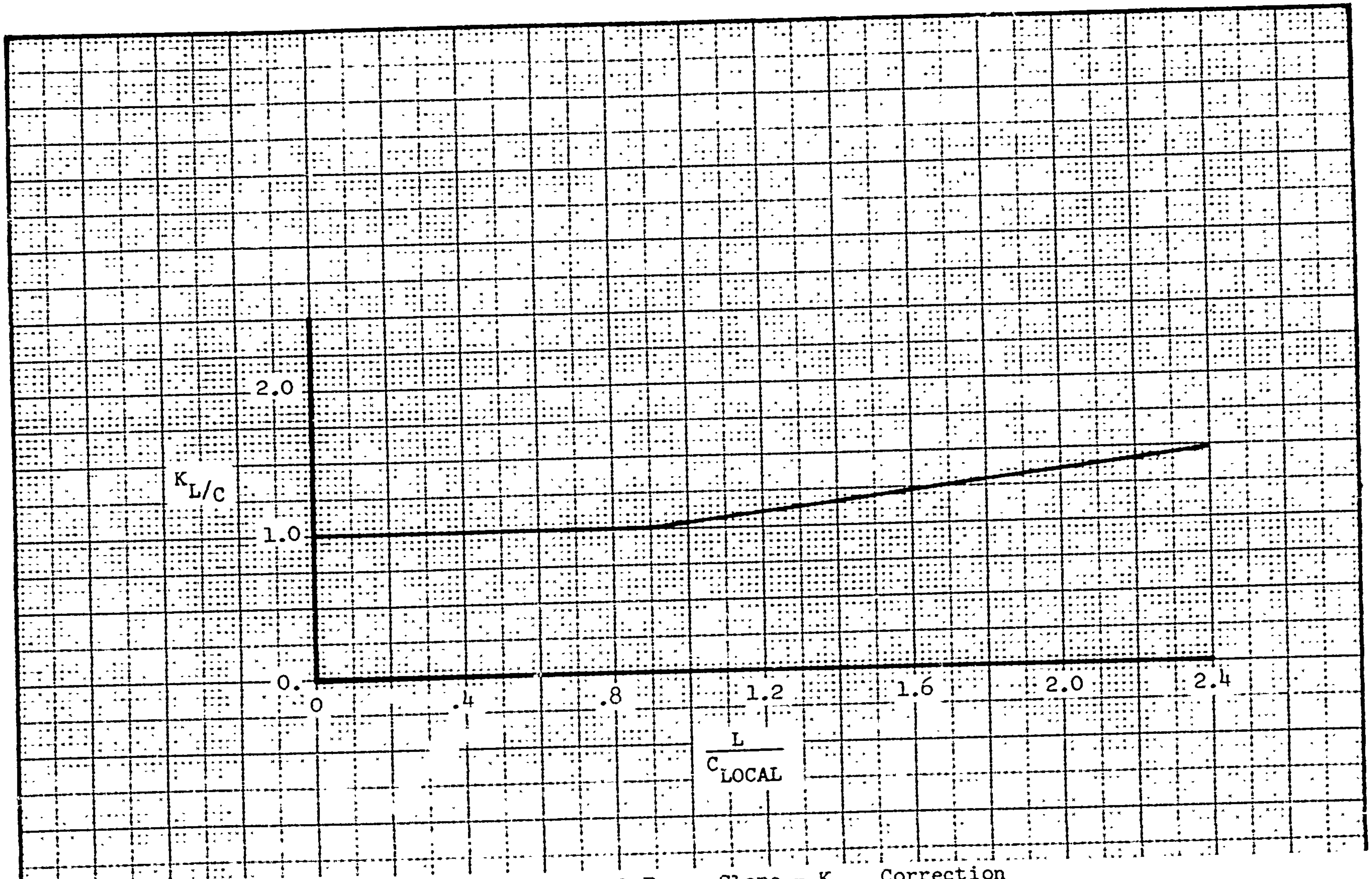

Figure 131. Normal Force Slope - $K_{L/C}$ Correction

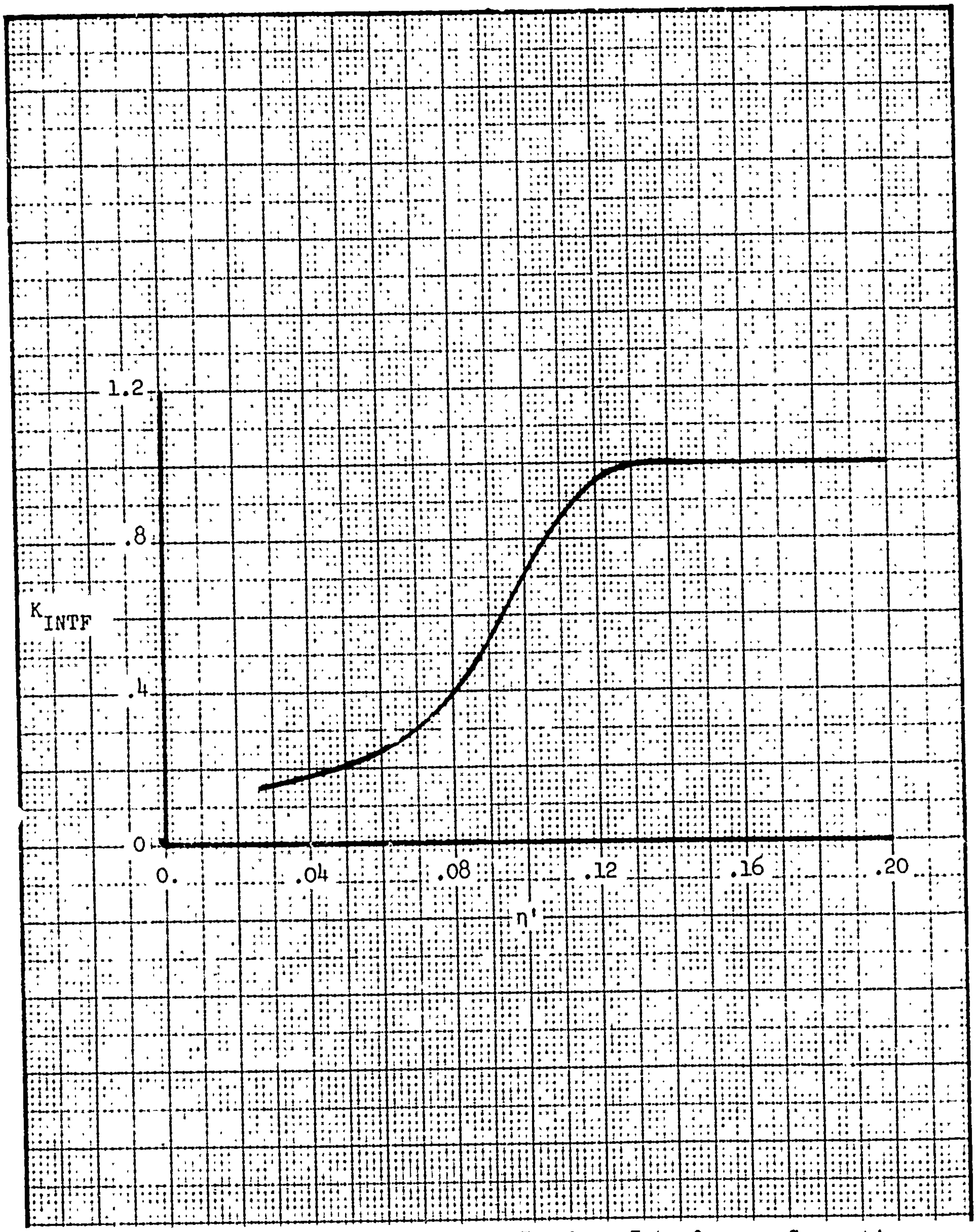

Figure 132. Normal Force Slope - Fuselage Interference Correction

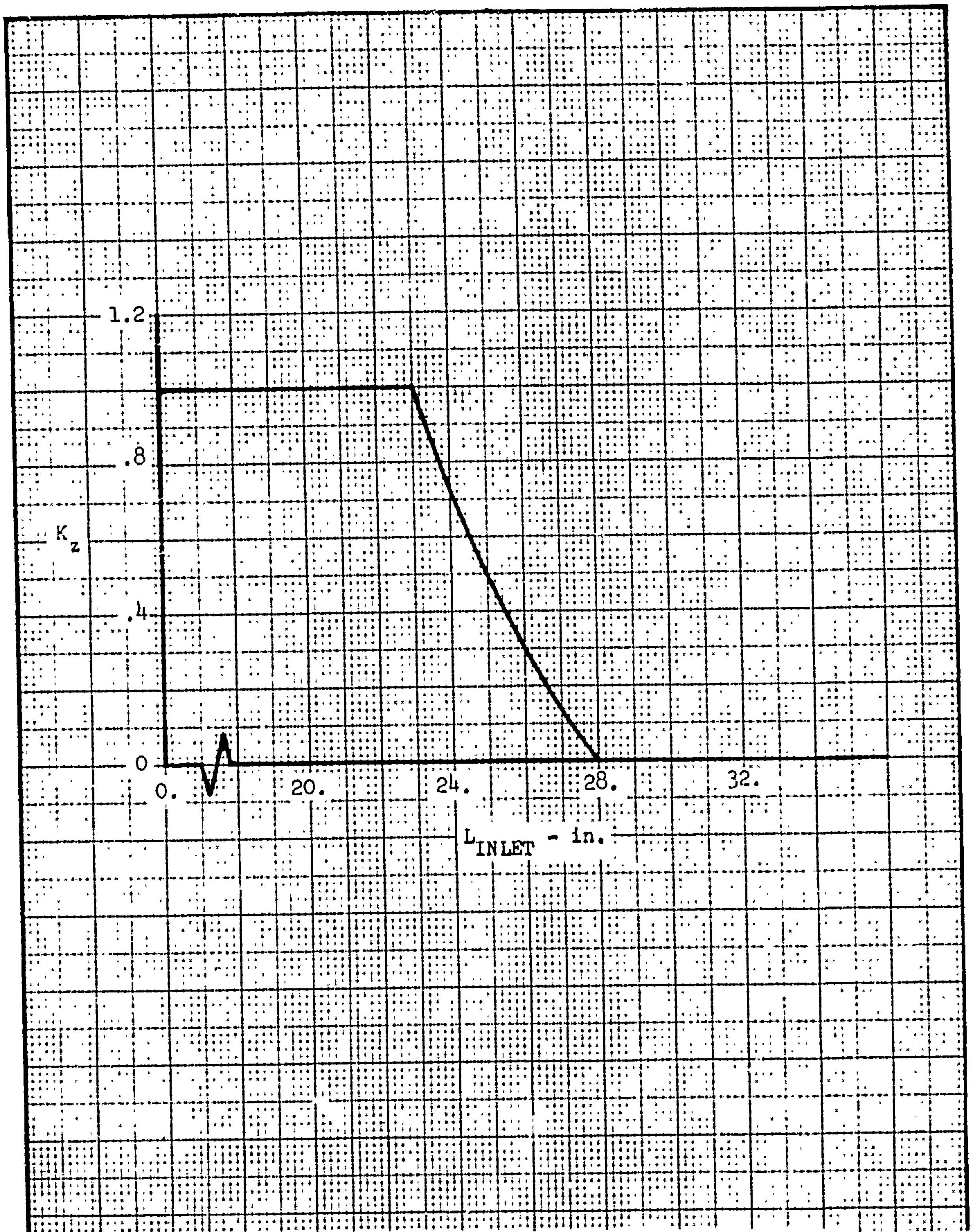

Figure 133. Normal Force Slope - Interference Correction

3.3.1.2 Slope Mach Number Correction

To compute the slope of captive store normal force as a function of angle of attack at a Mach number between $M = 0.5$ and $M = 2.0$, use the following equation.

$$\left(\frac{NF}{q}\right)_{\alpha_{M=x}} = \left(\frac{NF}{q}\right)_{\alpha_{PRED}} + \Delta\left(\frac{NF}{q}\right)_{\alpha_{M=x}}$$

where:

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{M=x}} = S_{REF}\, K_M\, \Delta^2 C_{N_{\alpha_M}}$$

We define the generalized curve of the variation of C_{N_α} with Mach number as having the shape given in Figure 137.

$$\Delta^2 C_{N_{\alpha_M}} = C_{N_{\alpha_{MI=0.7}}} - C_{N_{\alpha_{MI=0.0}}} = f\,(K_{\eta_M},\ K_{\Lambda_2},\ \text{ADJ. PPA},\ C_{LOCAL}),$$

see Figure 136.

where:

MI - Mach Index, defined as the difference between the actual Mach number and the Mach number where $\left(\frac{NF}{q}\right)_\alpha$ deviates from the subsonic M=0.5 value (MI=0), Figure 134.

K_M - Curve shape factor based on Mach Index, Figure 137.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

K_{η_M} - Spanwise correction factor based on η, Figure 135.

Example:

Compute $\left(\frac{NF}{q}\right)_\alpha$ at M=1.2 for a 300-gallon tank on the A-7 center wing pylon.

Required for Computation:

$\eta = .418$

$C_{LOCAL} = 127.6$ in.

$$K_{\Lambda_2} = \frac{\cos 35^\circ}{\cos 45^\circ} = 1.158$$

ADJ. PPA = 13,618 in ^{2}

S_{REF} = 3.83 ft ^{2}

Λ_{FIN} = 44 deg

$\left(\frac{NF}{q}\right)_{\alpha_{PRED}} = -.061 \frac{ft^2}{deg}$ - Subsection 3.3.1.2

$M_{MI=0.0} = .8$ - Figure 134

$MI = 1.2 - .8 = .4$

$K_M = .92$ - Figure 137

$K_{\eta_M} = .88$ - Figure 135

$$\frac{K_{\eta_M} K_{\Lambda_2} \text{ADJ.PPA}}{C_{LOCAL}} = 109 \text{ in.}$$

$\Delta^2 C_{N_{\alpha_M}} = .057$ - Figure 136

$$\left(\frac{NF}{q}\right)_{\alpha_{M=1.2}} = -.061 + (3.83)(.92)(.057)$$

$$\left(\frac{NF}{q}\right)_{\alpha_{M=1.2}} = .139 \frac{ft^2}{deg}$$

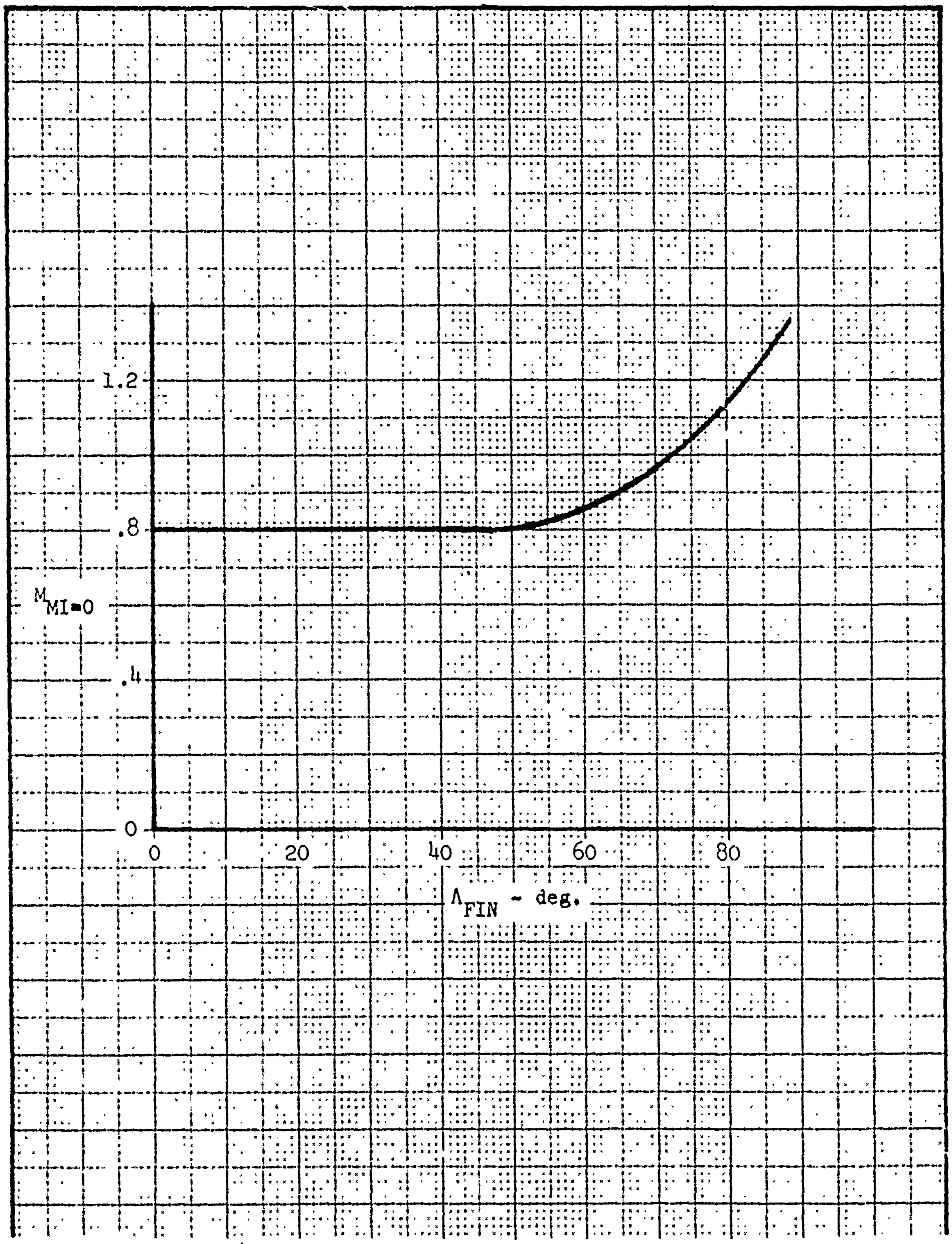

Figure 134. Normal Force Slope - Mach Index = 0 Variation

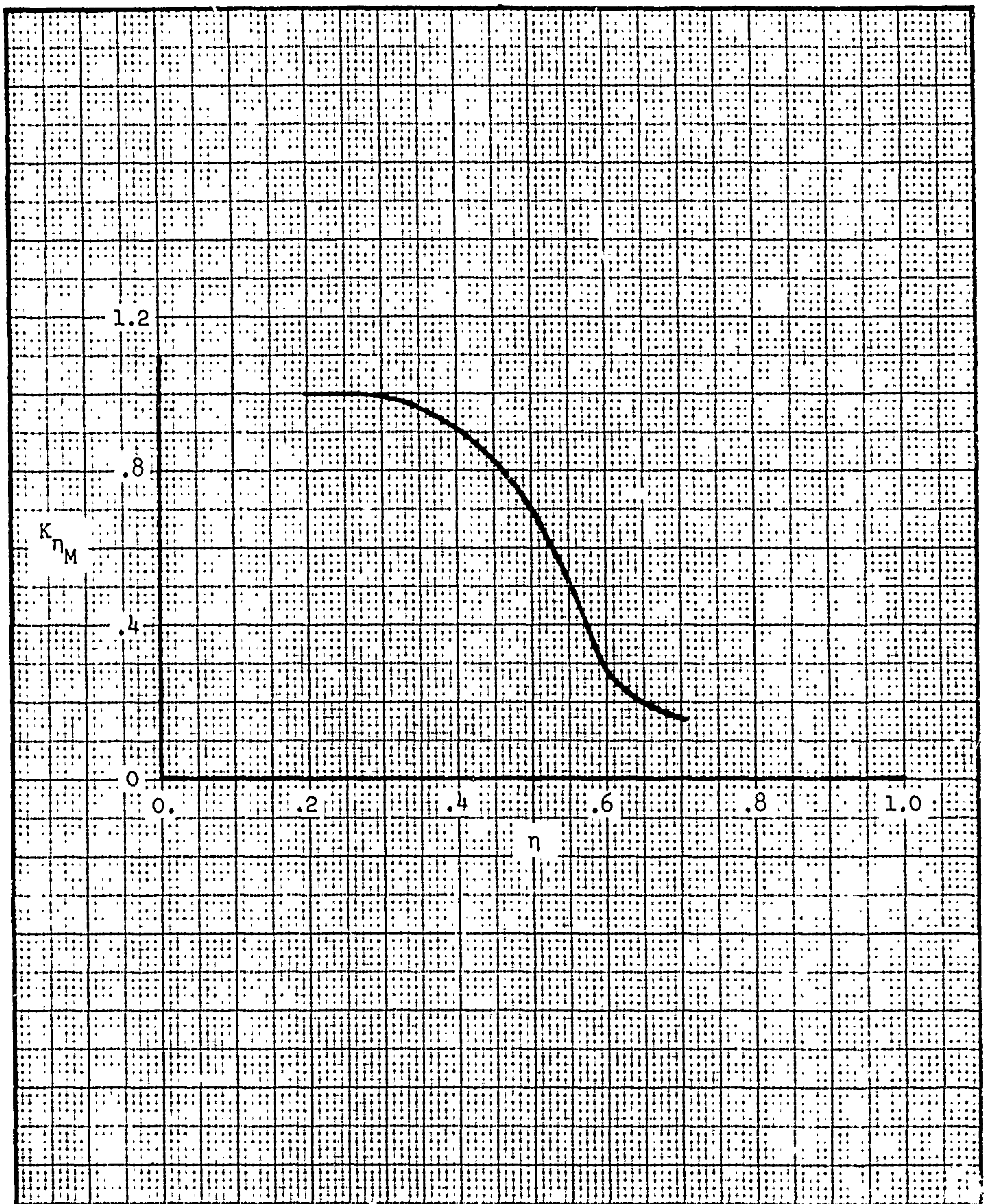

Figure 135. Normal Force Slope - Spanwise Correction

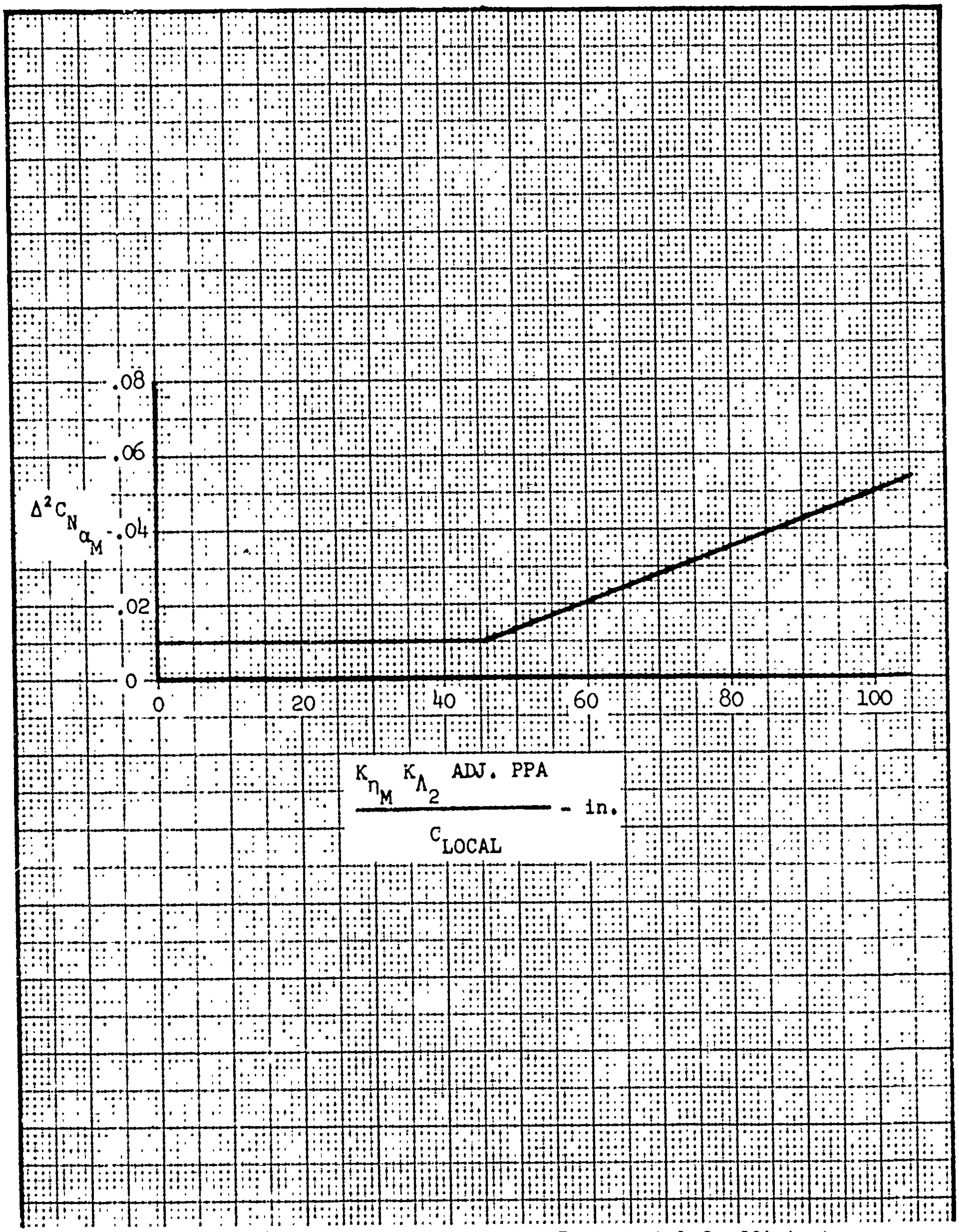

Figure 136. Normal Force Slope - Incremental Coefficient at MI = 0.7

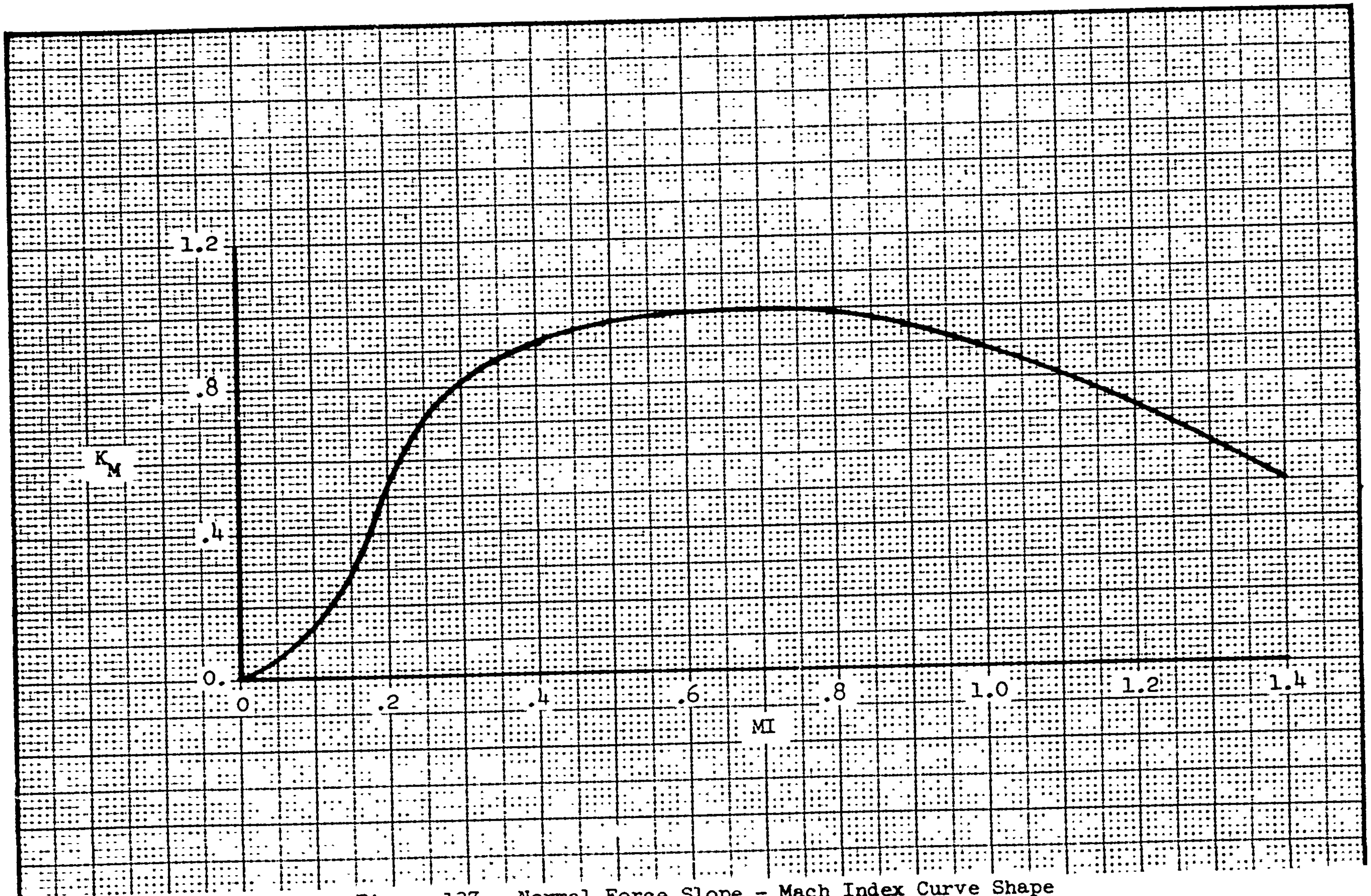

Figure 137. Normal Force Slope - Mach Index Curve Shape Variation

3.3.1.3 **Intercept Prediction**

The value of captive store normal force at $\alpha = 0$ is calculated using the following equation.

$$\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\ PRED}} = S_{REF}\left(K_{INTC_1} + K_{SLOPE_1}\, K_{\Lambda_2}\, \ell_{LE} + \frac{\Delta K_{INTC_Z}}{K_{\Lambda_2}} + K_{x/c}\, \Delta K_{INTC_{x/c}}\right)$$

where

K_{INTC_1} - Value of $\left(\frac{NF}{qS_{REF}}\right)_{\alpha=0}$ at $\ell_{LE}=0$, Figure 138.

K_{SLOPE_1} - Variation of $\left(\frac{NF}{qS_{REF}}\right)_{\alpha=0}$ with respect to ℓ_{LE},

$$\frac{\partial\left(\frac{NF}{qS_{REF}}\right)_{\alpha=0}}{\partial \ell_{LE}} = -.0109\ \frac{1}{\text{in.}}$$

ℓ_{LE} - Distance from the nose of the installed store to the wing leading edge measured in the wing plan view, in.

ΔK_{INTC_Z} - Intercept correction based on pylon height, Figure 139.

$K_{x/c}$ - Intercept correction factor based on x/c_{ML} for the installed store, Figure 140.

$\Delta K_{INTC_{x/c}}$ - Intercept correction based on the installed store cross sectional area, $\frac{\pi d^2}{4}$, Figure 141.

Example:

Calculate $\left(\frac{NF}{q}\right)_{\alpha=0}$ for a 300-gallon tank on the A-7 center wing pylon.

Required for Computation:

$C_{LOCAL} = 127.6$ in.

$Z = 23$ in.

$\left(\frac{x}{c}\right)_{ML} = .16$

$S_{REF} = 3.83 \text{ ft}^2$

$K_{\Lambda_2} = 1.158$

$\ell_{LE} = 75.1$ in.

$K_{INTC_1} = 1.18$ - Figure 138.

$K_{SLOPE_1} = -.0109 \frac{1}{\text{in.}}$

$\Delta K_{INTC_Z} = 0$ - Figure 139

$K_{x/c} = 0$ - Figure 140

$\Delta K_{INTC_{x/c}} = 1.12$ - Figure 141

$$\left(\frac{NF}{q}\right)_{\alpha=0} = 3.83\ (1.18+(-.0109)(1.158)(75.1) + (\frac{0}{1.158}) + (0)\ (1.12))$$

$$\left(\frac{NF}{q}\right)_{\alpha=0} = .888 \text{ ft}^2$$

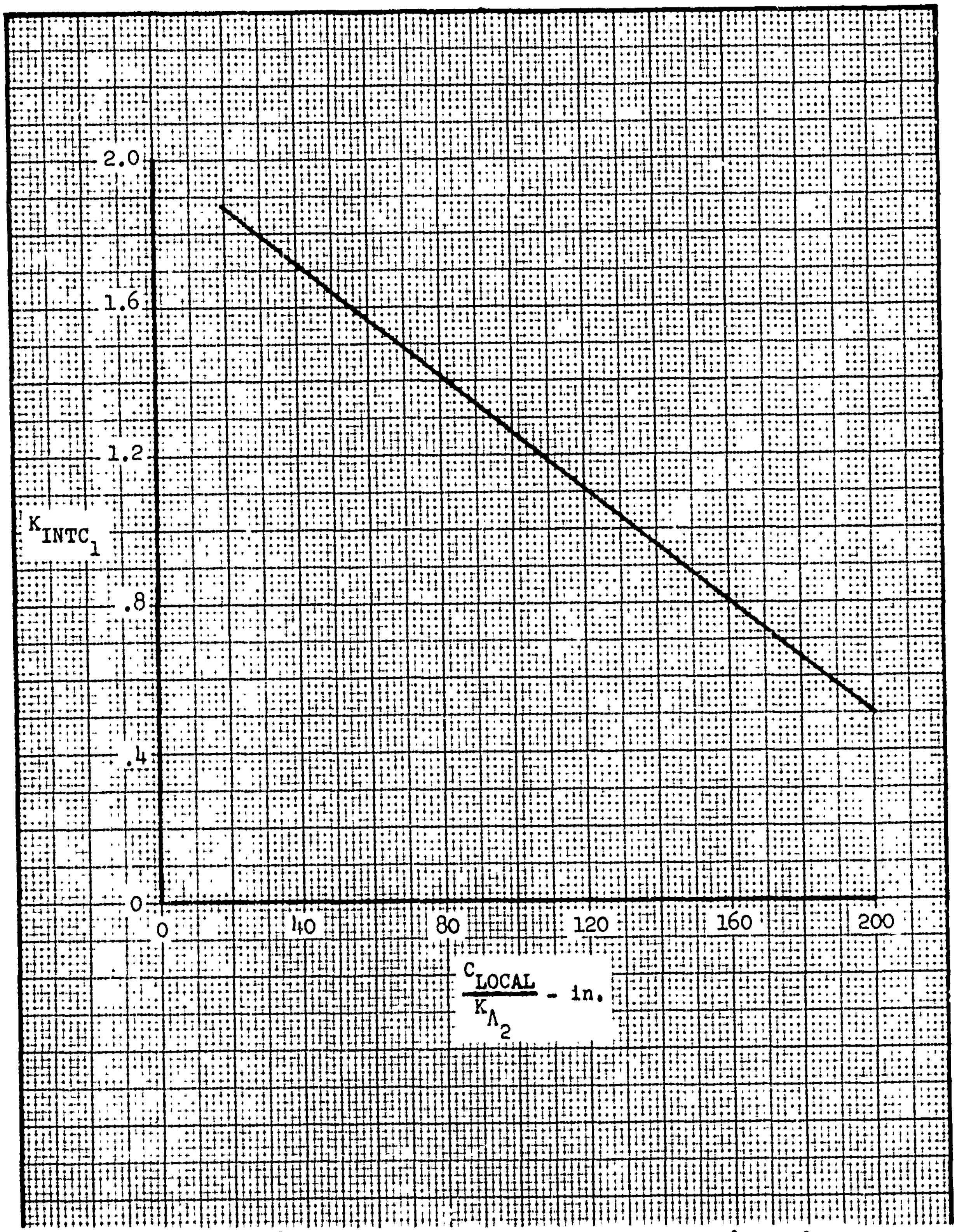

Figure 138. Normal Force Intercept - Value at $\ell_{LE} = 0$

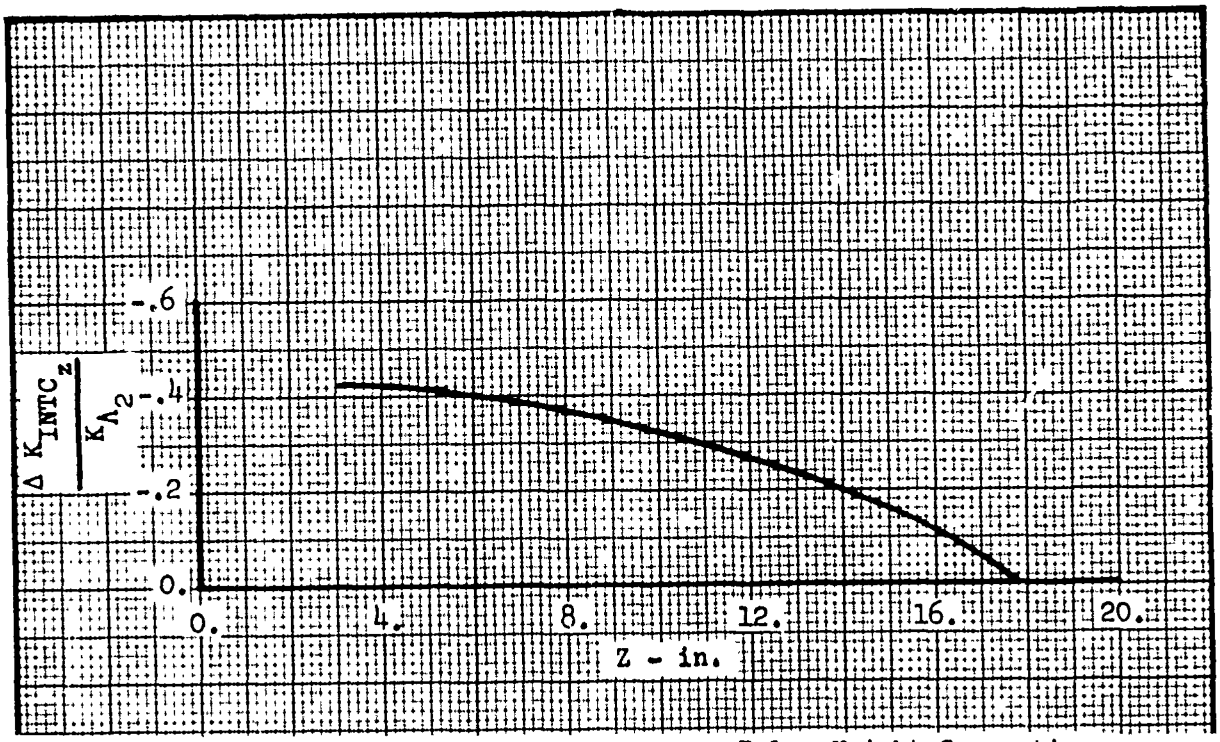

Figure 139. Normal Force Intercept - Pylon Height Correction

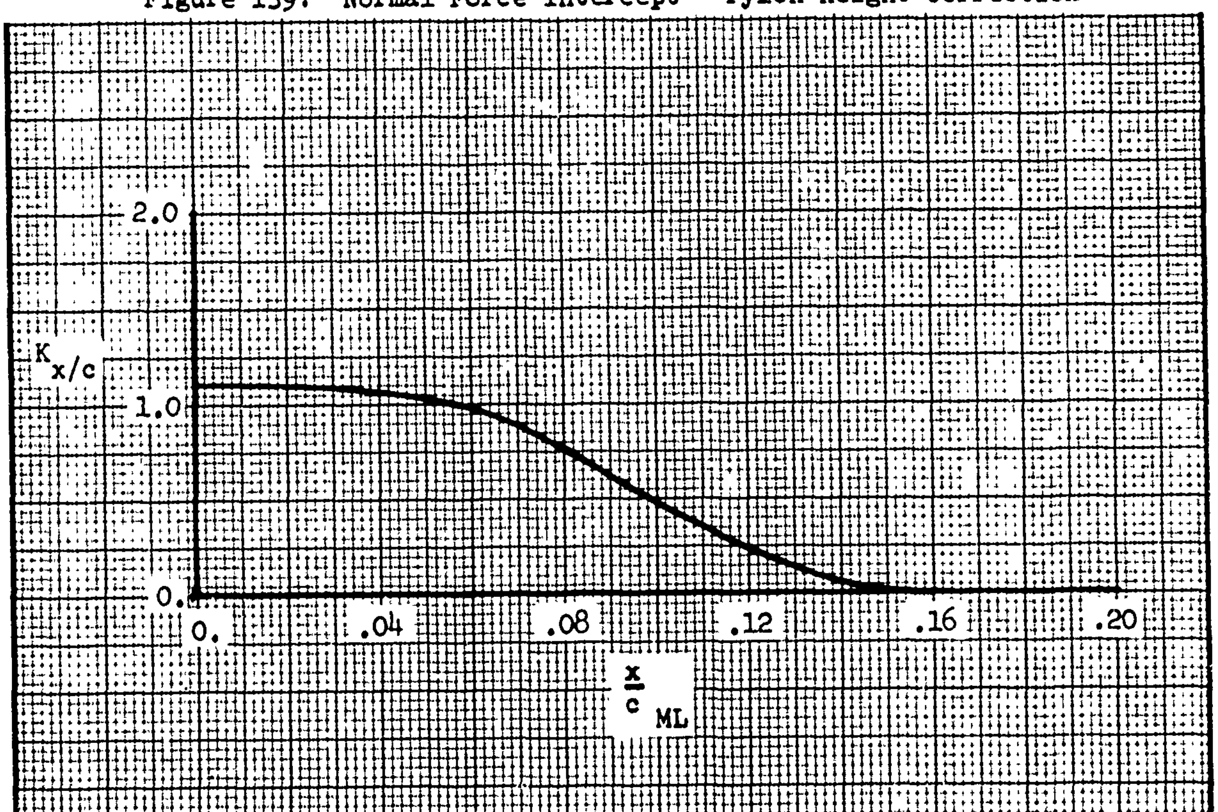

Figure 140. Normal Force Intercept - Chordwise Position Correction Factor

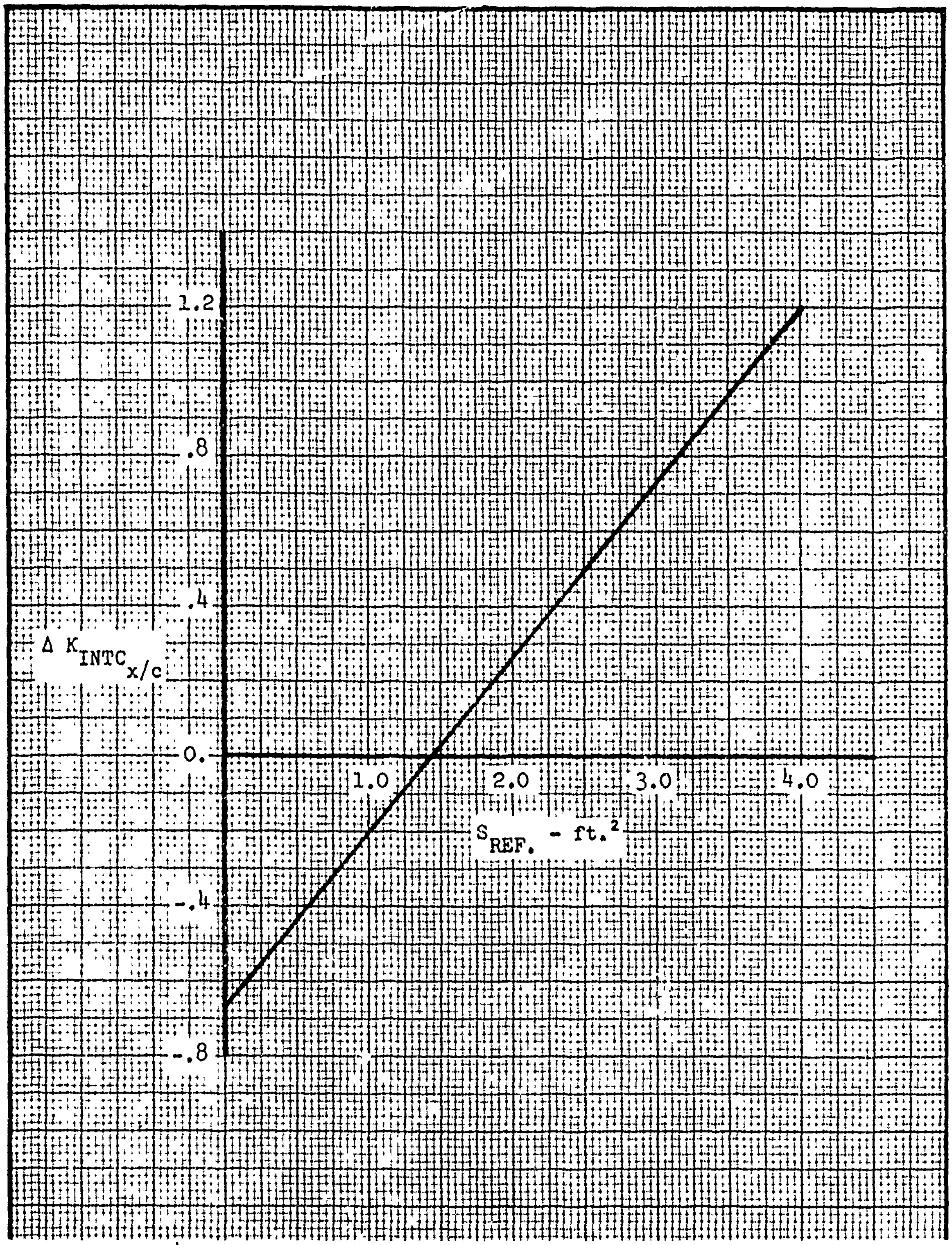

Figure 141. Normal Force Intercept - Chordwise Position Correction

3.3.1.4 Intercept Mach Number Correction

To compute the value of captive normal force at $\alpha=0$ between M = 0.5 and M = 2.0, use the following equation.

$$\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{NF}{q}\right)_{\substack{\alpha=0\\PRED}} + \Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\M=x}}$$

where:

$$\Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\M=x}} = \frac{S_{REF}\, K_{SLOPE_1}\, MI}{K_{L_n/d}}$$

MI	- Mach Index, defined as the difference between the actual Mach number and the product of K_{MI} and the Mach number where $\left(\frac{NF}{q}\right)_{\alpha=0}$ deviates from the subsonic M=0.5 value (MI=0), Figure 134.
K_{MI}	- Spanwise correction factor to the Mach number at MI=0, Figure 145.
K_{SLOPE_1}	- Variation of $\Delta\left(\frac{NF}{q}\right)_{\alpha=0}$ with respect to MI, $\frac{\partial\Delta\left(\frac{NF}{q}\right)_{\alpha=0}}{\partial MI}$, f($S_{REF}$, K_{Λ_2}, K_{FIN}, ADJ. NOSE PPA, ADJ. FIN PPA), ft ^{2}, Figure 142.
$K_{L_n/d}$	- Slope correction factor based on the ratio of store nose length to store diameter, Figure 143.
K_{FIN}	- Fin area correction factor based on the ratio of y/Y, Figure 144.
ADJ. NOSE PPA	- Adjusted nose plan projected area, in ^{2}, see Subsection 2.3.2.
$[\text{ADJ. FIN PPA}]_{x/c=1.0}^{x/c=1.1}$	- Adjusted fin plan projected area between x/c=1.0 and x/c=1.1, in ^{2}, see Subsection 2.3.2.

Example:

Compute $\left(\frac{NF}{q}\right)_{\alpha=0}$ at M=1.2 for a 300-gallon tank on the A-7 center wing pylon.

Required for Computation:

$\eta = .418$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_2} = 1.158$

$S_{REF} = 3.83 \text{ ft}^2$

ADJ. NOSE PPA = 10,568 in ^{2}

$[\text{ADJ. FIN PPA}]_{x/c=1.0}^{x/c=1.1} = 1387 \text{ in}^2$

$\frac{Ln}{d} = 3.74$

$\frac{\bar{Y}}{Y} = \frac{68.2}{203.4} = .33$

$\Lambda_{FIN} = 44$ deg

$M_{MI=0.0} = .8$ - Figure 134

$K_{MI} = .9$ - Figure 145

$MI = 1.2-(.9)(.8)$

$MI = .48$

$K_{FIN} = 4.0$ - Figure 144

$$\frac{\text{ADJ. NOSE PPA}}{S_{REF}\, K_{\Lambda_2}^2} - K_{FIN}\left[\frac{\text{ADJ. FIN PPA}}{S_{REF}}\right]_{x/c=1.0}^{x/c=1.1} = \frac{10568}{(3.83)(1.158)^2} -$$

$$4.0\left(\frac{1387}{3.83}\right) = 610 \frac{\text{in}^2}{\text{ft}^2}$$

$K_{SLOPE_1} = -1.35$ — Figure 142

$K_{L_n/d} = 1.0$ — Figure 143

$\Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ PRED}} = .888 \text{ ft}^2$ — Subsection 3.3.1.3

$$\Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ M=1.2}} = \frac{(3.83)(-1.35)(.48)}{1.0}$$

$$\Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ M=1.2}} = -2.48 \text{ ft}^2$$

$$\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ M=1.2}} = .888 - 2.48$$

$$\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ M=1.2}} = -1.59 \text{ ft}^2$$

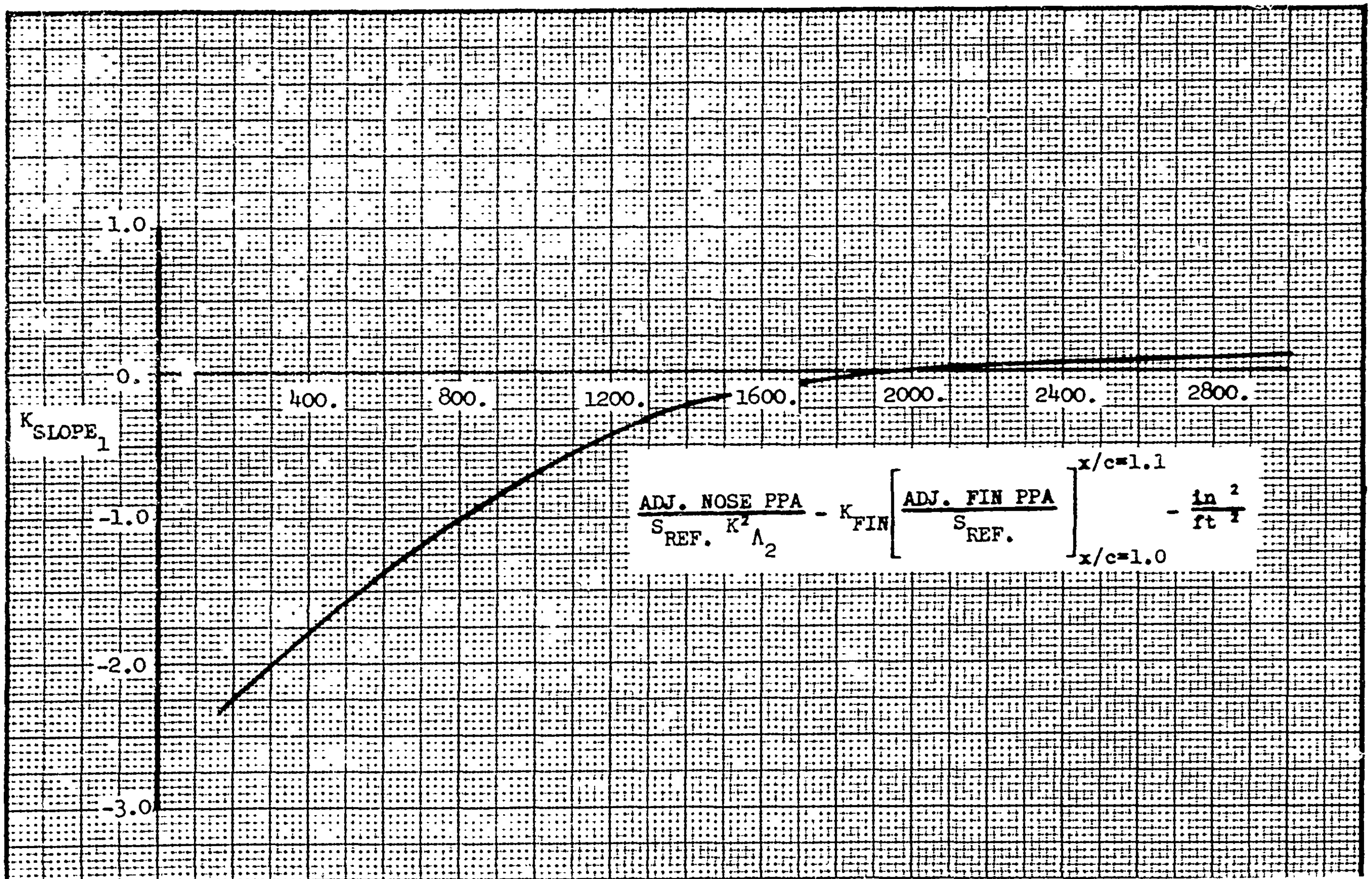

Figure 142. Normal Force Intercept - Incremental Coefficient Variation

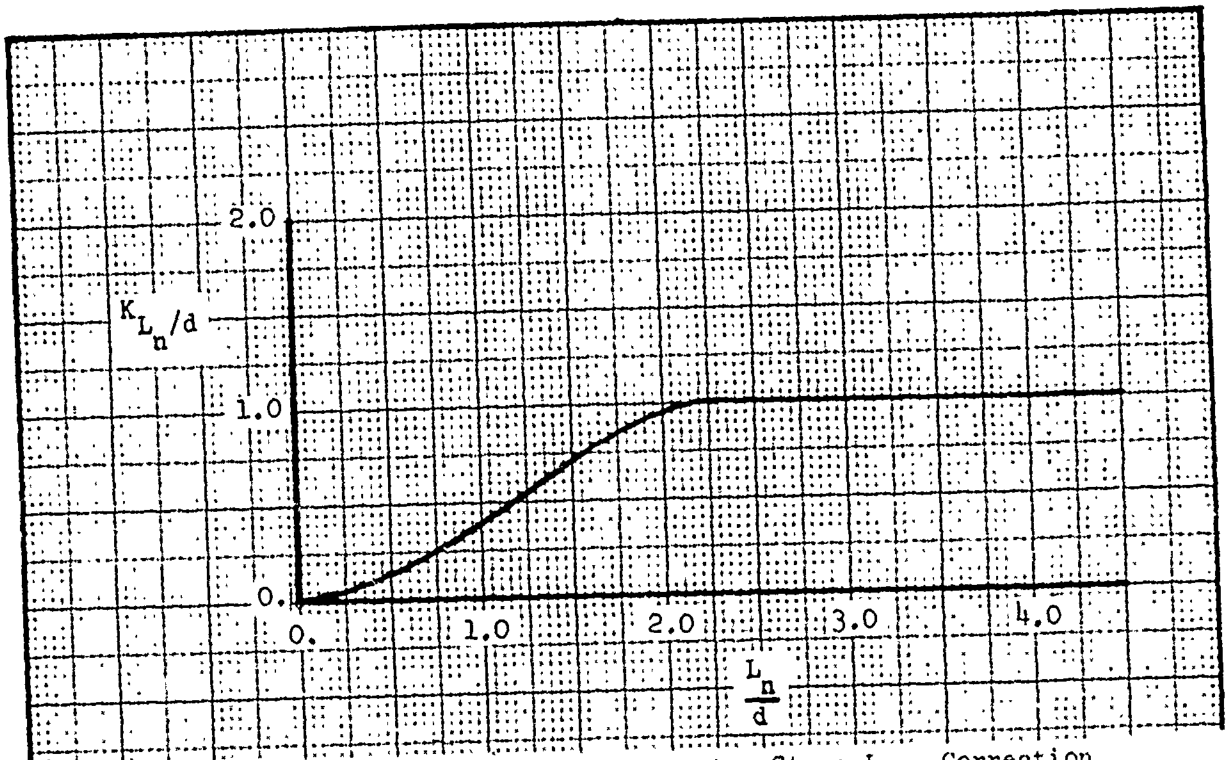

Figure 143. Normal Force Intercept - Store $L_{n/d}$ Correction

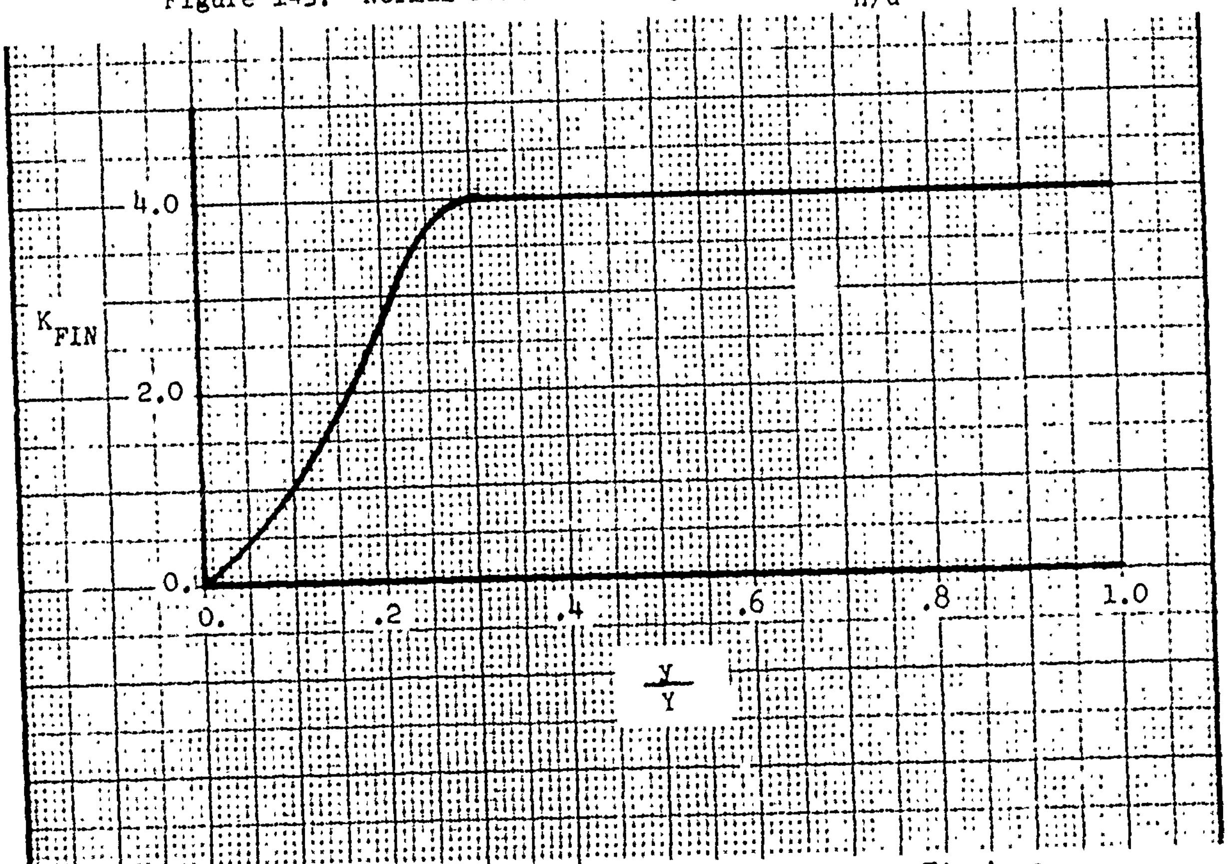

Figure 144. Normal Force Intercept - Store Fin Area Correction

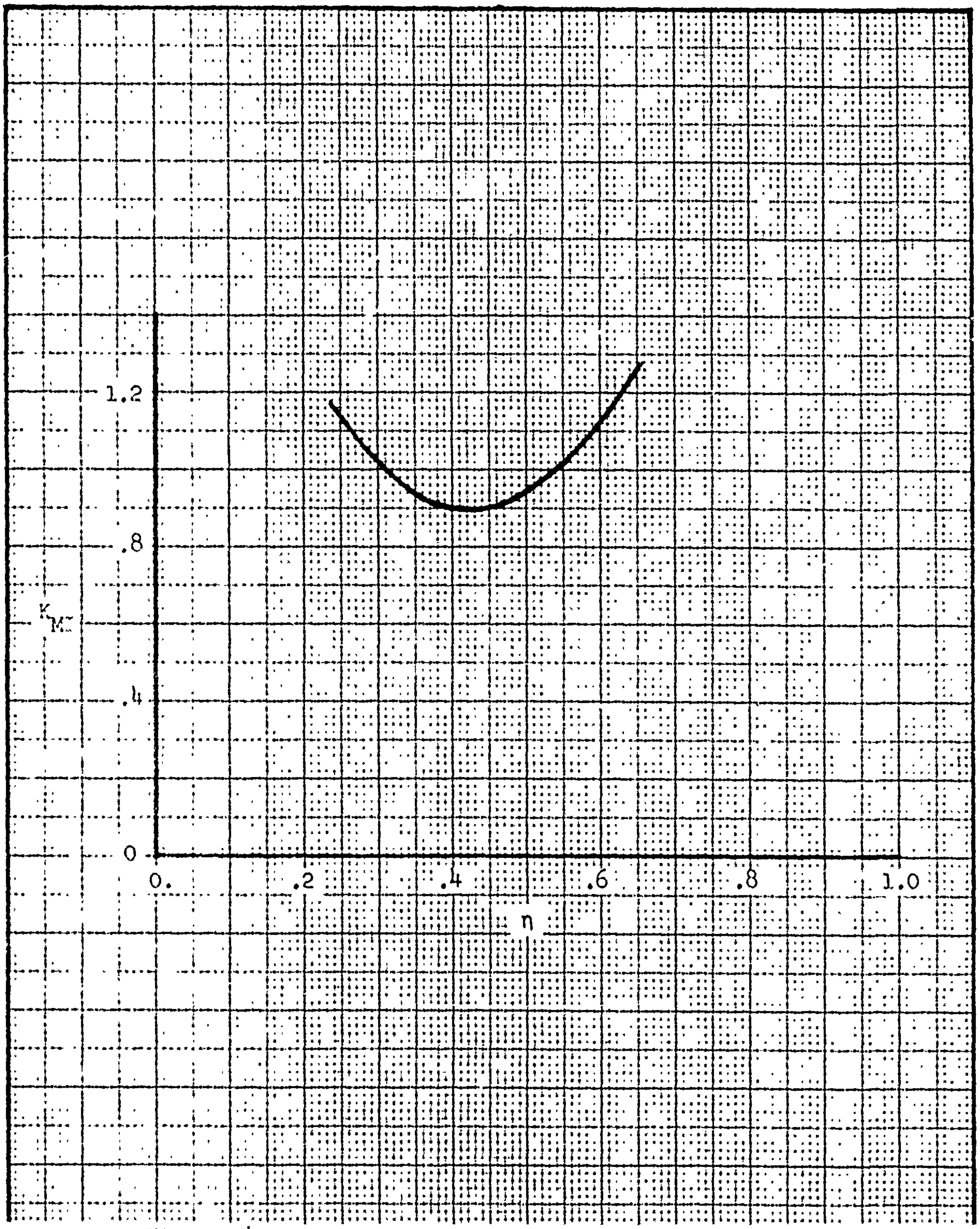

Figure 145. Normal Force Intercept - Spanwise Correction

3.3.2 Increment-Aircraft Yaw

The general discussion of incremental effects due to aircraft yaw for normal force slope and intercept is similar to that of incremental side force as found in Subsection 3.1.2.

3.3.2.1 Slope Prediction

The equation for predicting the incremental normal force slope per degree β_S, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}}$, for M = 0.5 is as follows:

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})\,\ell_{LE} + K_{INTC_1} + \Delta K_{INTC_{INTF}}]\,S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental C_{N_α} per degree β_S with ℓ_{LE}, $\frac{1}{\text{in.-deg}^2}$, Figure 146.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{in.-deg}^2}$, Figure 147.

ℓ_{LE} - Distance that the store extends forward of the wing leading edge measured along the store longitudinal axis, in.

K_{INTC_1} - Value of $\Delta C_{N_{\alpha_{\beta_S}}}$ when $\ell_{LE} = 0$, $\frac{1}{\text{deg}^2}$, Figure 148.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{deg}^2}$, Figure 149.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}

Example: Compute $\Delta\left(\frac{NF}{q}\right)_\alpha$ for a 300-gallon tank on the A-7 center pylon at M=0.5 and β_S=4°.

Required for Computation:

S_{REF} = 3.83 ft ^{2}

η' = .27

ℓ_{LE} = 75.1 in.

C_{LOCAL} = 127.6 in.

K_{Λ_2} = 1.158

K_{SLOPE_1} = -.00011	- Figure 146,	$+\beta_S$ curve
$\Delta K_{SLOPE_{INTF}}$ = 0.0	- Figure 147,	$+\beta_S$ curve
K_{INTC_1} = .0030	- Figure 148,	$+\beta_S$ curve
$\Delta K_{INTC_{INTF}}$ = 0.0	- Figure 149,	$+\beta_S$ curve

Substituting,

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}} = [(-.00011+0.0)\ (75.1) + .0030 + 0.0]\ 3.83$$
$$= -.0201\ \frac{ft^2}{deg^2}$$

and using the equation of Subsection 3.3.2

$$\Delta\left(\frac{NF}{q}\right)_\alpha = \Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}} \cdot \beta_S$$
$$= (-.0201)\ (4) = -.0804\ \frac{ft^2}{deg}$$

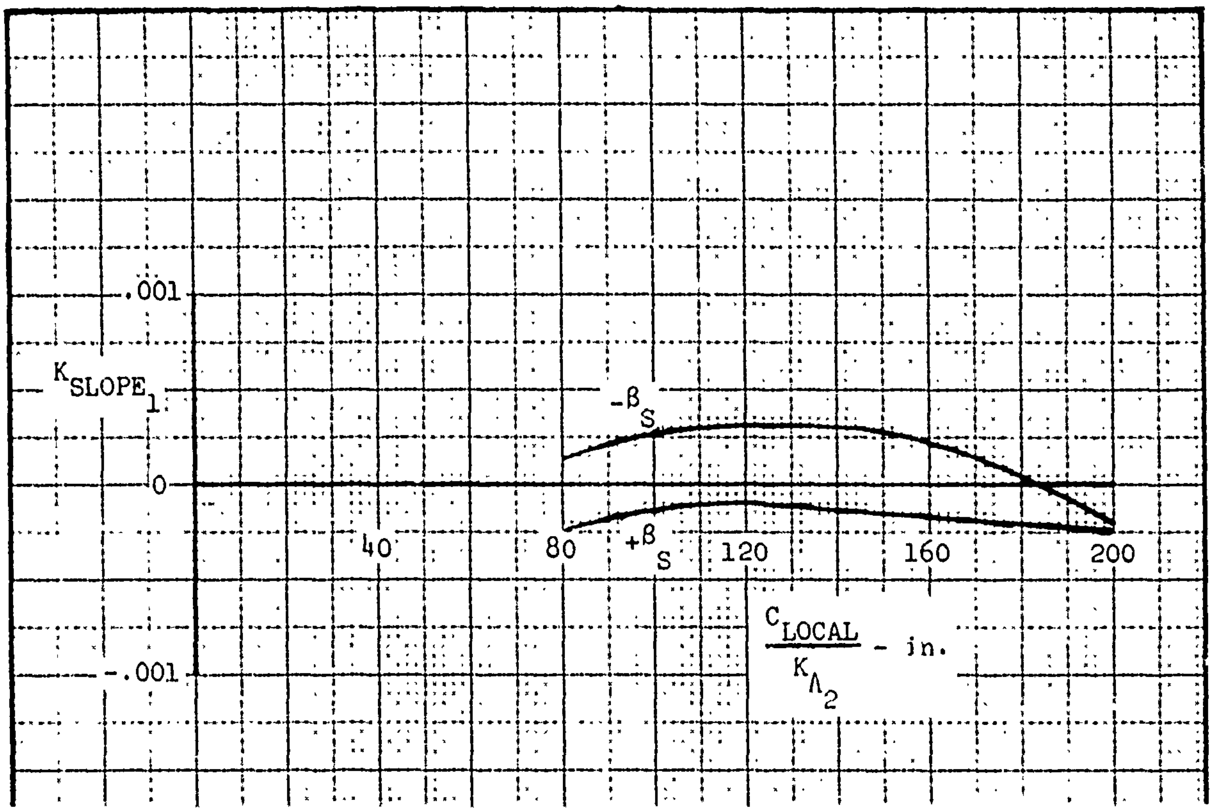

Figure 146. Incremental Normal Force Slope Due to Yaw - K_{SLOPE} for Positive and Negative Store Yaw

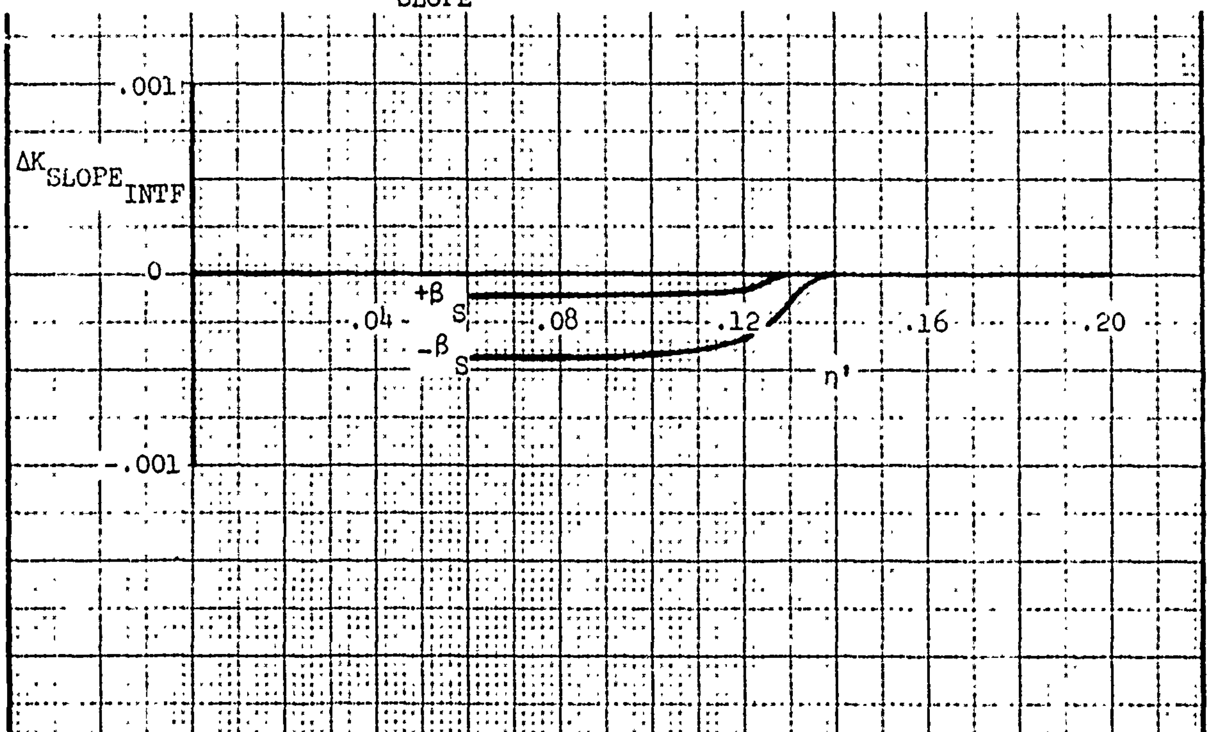

Figure 147. Incremental Normal Force Slope Due to Yaw - K_{SLOPE} Fuselage Interference Correction

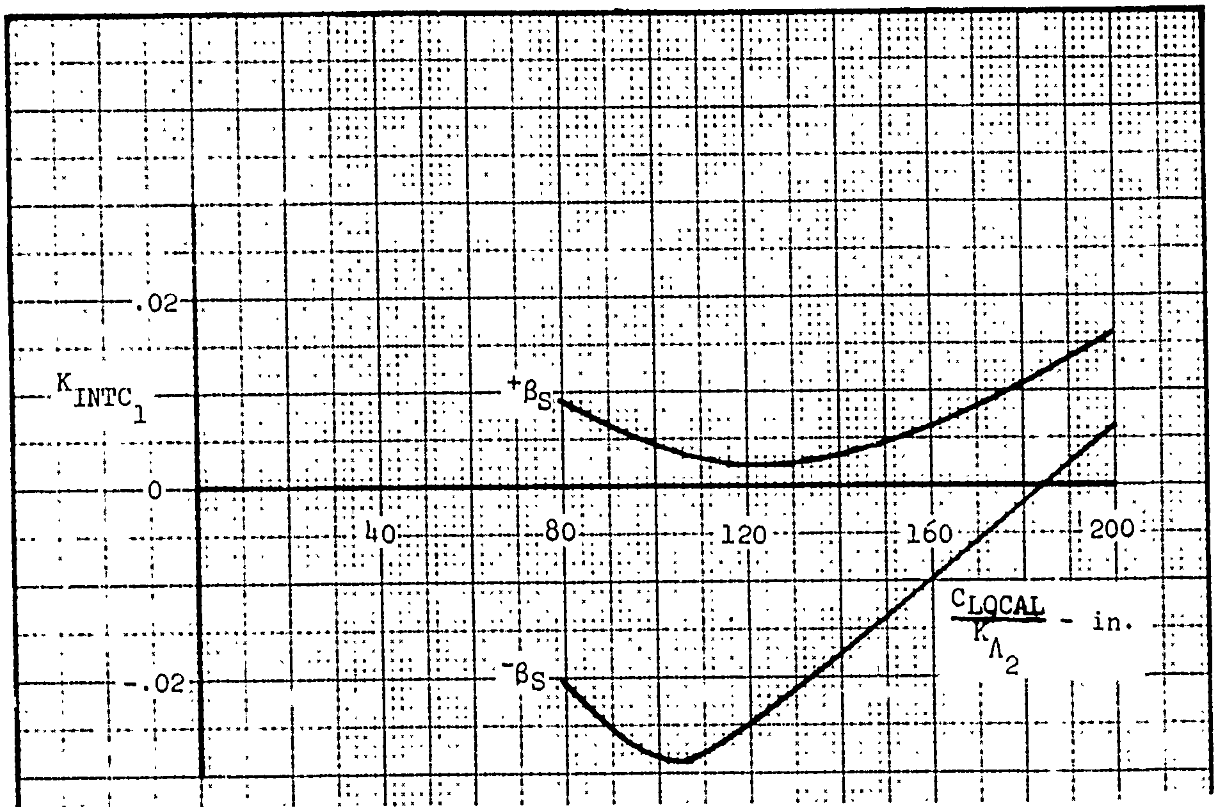

Figure 148. Incremental Normal Force Slope Due to Yaw - K_{INTC} for Positive and Negative Store Yaw

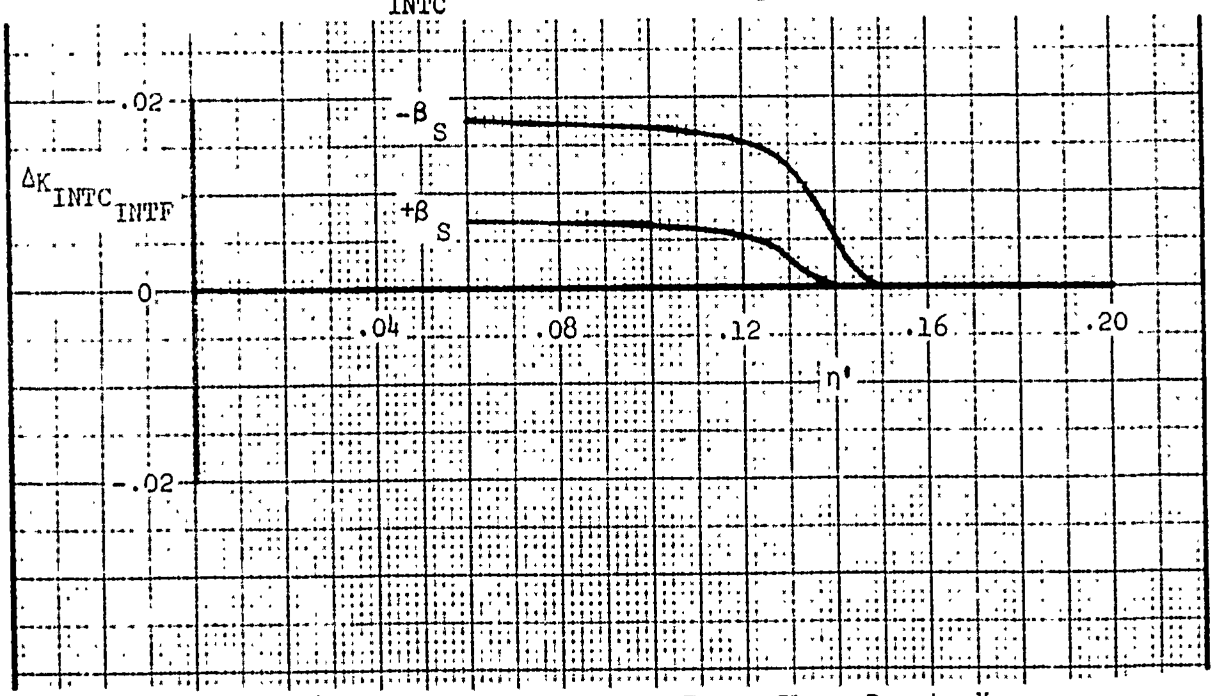

Figure 149. Incremental Normal Force Slope Due to Yaw - K_{INTC} Fuselage Interference Correction

3.3.2.2 Slope Mach Number Correction

To compute the incremental normal force slope per degree β_S, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}}$, between M=0.5 and M=2.0, use the equation below.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=x}}}} = \Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$$

where:

$\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}}$ - Incremental normal force slope per degree β_S predicted at M=0.5, from Subsection 3.3.2.1.

$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ - Incremental change with Mach number of the incremental normal force slope per degree β_S at M=0.5.

A generalized curve depicting the incremental normal force variation with Mach number is given by Figure 150.

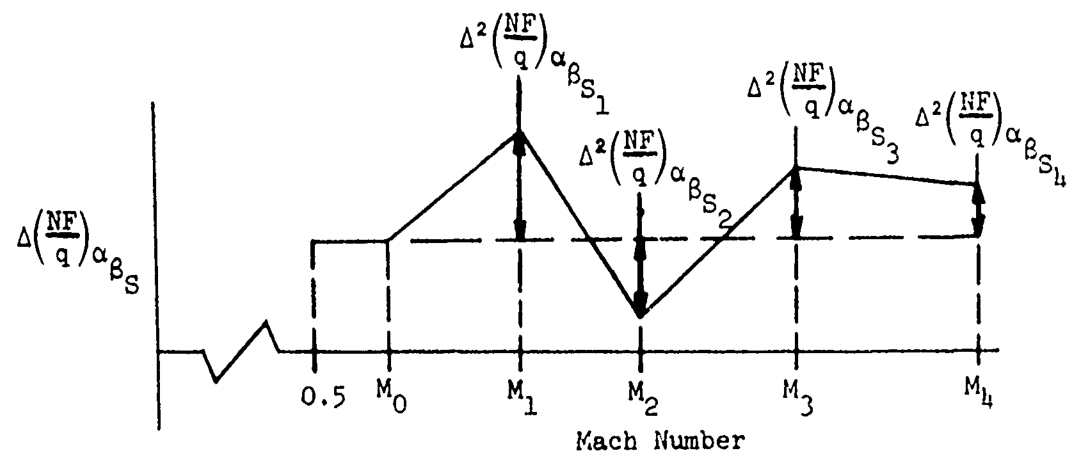

Figure 150. Incremental Normal Force Slope Due to Yaw - Generalized Mach Number Variation

The incremental slope variation with Mach number has been fitted by a series of linear segments with breaks at Mach numbers defined by M_o, M_1, M_2, M_3, and M_4. The Mach break points are presented in Figures 151 and 152 as a function of $\frac{C_{LOCAL}}{K_{\Lambda\ell}}$. M_o is the Mach number where the slope initially changes from the value predicted at M=0.5. Equations predicting the incremental changes from the M=0.5 value at each of the remaining Mach break points follow.

Break 1:

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_1}}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF_1}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF_1}}]\, S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental $C_{N_{\alpha_1}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.-deg.^2}$, Figure 153.

$\Delta K_{SLOPE_{INTF_1}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in.-deg^2}$, Figure 154.

$\frac{ADJ.PPA}{L}$ - Adjusted plan projected area divided by store length, in.

K_{INTC_1} - Value of $\Delta C_{N_{\alpha_{\beta_{S_1}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 155.

$\Delta K_{INTC_{INTF_1}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 156.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}

Break 2:

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_2}}} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF_2}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2} + \Delta K_{INTC_{INTF_2}}]\, S_{REF}$$

where:

K_{SLOPE_2} - Variation of incremental $C_{N_{\alpha_2}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.-deg^2}$, Figure 157.

$\Delta K_{SLOPE_{INTF_2}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in.-deg^2}$, Figure 158.

$\frac{ADJ.PPA}{L}$ - Adjusted plan projected area divided by store length, in.

K_{INTC_2} - Value of $\Delta C_{N_{\alpha_{\beta_{S_2}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 159.

$\Delta K_{INTC_{INTF_2}}$ - Incremental change in K_{INTC_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 160.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

Break 3:

$$\Delta^2 \left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_3}}} = [(K_{SLOPE_3} + K_{SLOPE_{INTF_3}}) \left(\frac{ADJ.PPA}{L}\right) + K_{INTC_3} + K_{INTC_{INTF_3}}] S_{REF}$$

where:

K_{SLOPE_3} - Variation of incremental $C_{N_{\alpha_3}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.-deg^2}$, Figure 161.

$\Delta K_{SLOPE_{INTF_3}}$ - Incremental change in K_{SLOPE_3} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{in.-deg.}^2}$, Figure 162.

$\frac{ADJ.PPA}{L}$ - Adjusted plan projected area divided by store length, in.

K_{INTC_3} - Value of $\Delta C_{N_{\alpha_{\beta_{S_3}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{\text{deg}^2}$, Figure 163.

$\Delta K_{INTC_{INTF_3}}$ - Incremental change in K_{INTC_3} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{deg}^2}$, Figure 164.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft.

Break 4:

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_4}}} = [(K_{SLOPE_4} + \Delta K_{SLOPE_{INTF_4}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4} + \Delta K_{INTC_{INTF_4}}]\, S_{REF}$$

where:

K_{SLOPE_4} - Variation of incremental $C_{N_{\alpha_4}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{\text{in.-deg.}^2}$, Figure 165.

$\Delta K_{SLOPE_{INTF_4}}$ - Incremental change in K_{SLOPE_4} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{in.-deg.}^2}$, Figure 166.

$\frac{ADJ.PPA}{L}$ - Adjusted plan projected area divided by store length, in.

K_{INTC_4} - Value of $\Delta C_{N_{\alpha_{\beta_{S_4}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 167.

$\Delta K_{INTC_{INTF_4}}$ - Incremental change in K_{INTC_4} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 168.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

To compute $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}}$ at M=x, first determine from Fig. 151 or 152 between which Mach number break points M=x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}}$ at M=x from the following relation.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=x}}}} = \Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M_{LOW}}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)$$

$$\left[\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M_{HI}}}}} - \Delta^2\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M_{LOW}}}}} \right]$$

If x > M = 1.6, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ is equal to the value of $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}}$ at M = 1.6.

If $x \leq M_o$, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ is equal to the value of $\Delta\left(\frac{NF}{q}\right)_{\alpha_{\beta_S}}$ at M = 0.5 from Subsection 3.3.2.1 (the initial term in the above equation).

A numerical example showing the use of the above equation is contained in Subsection 3.2.2.2.

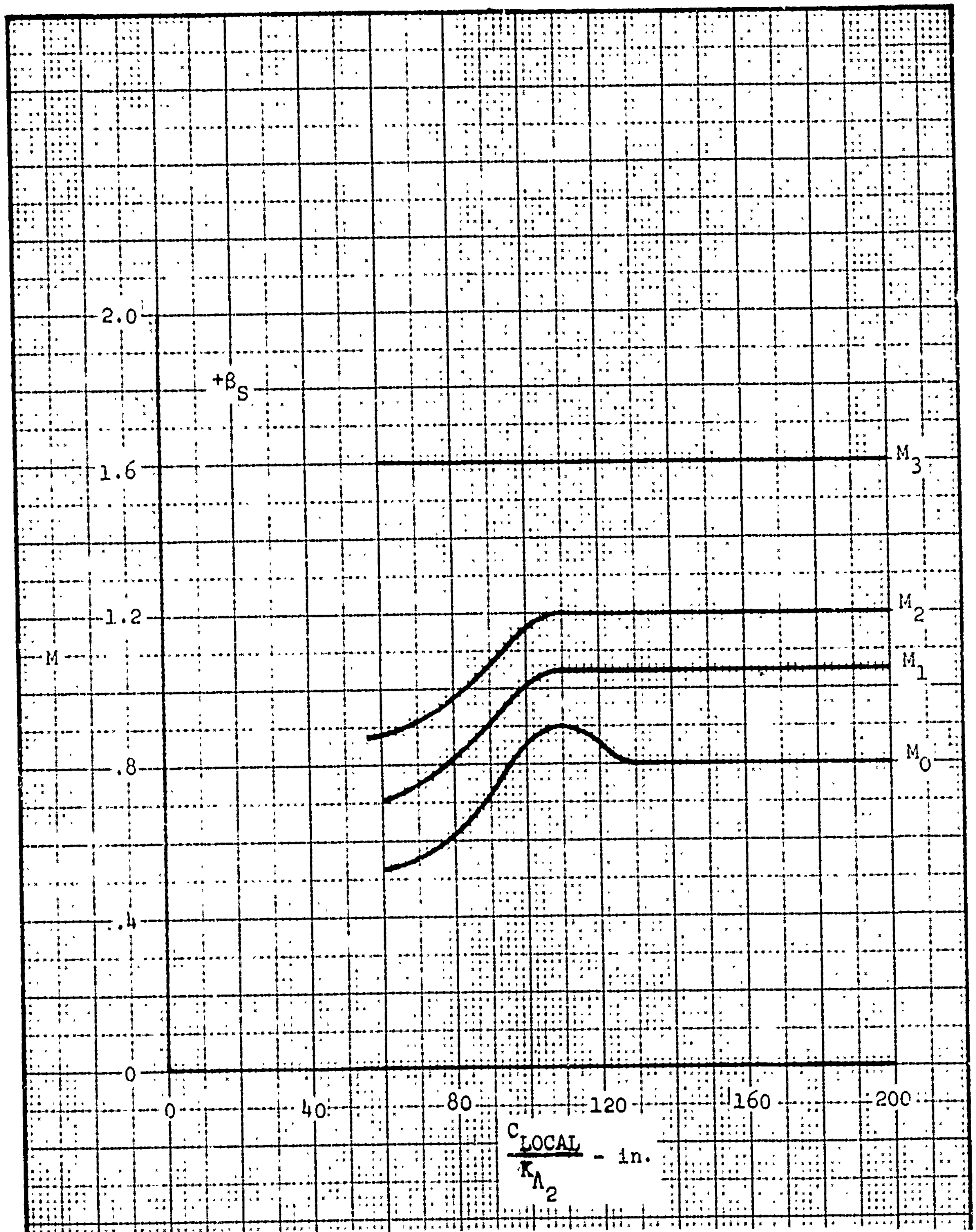

Figure 151. Incremental Normal Force Slope Due to Yaw - Mach Number Break Points for Positive Store Yaw

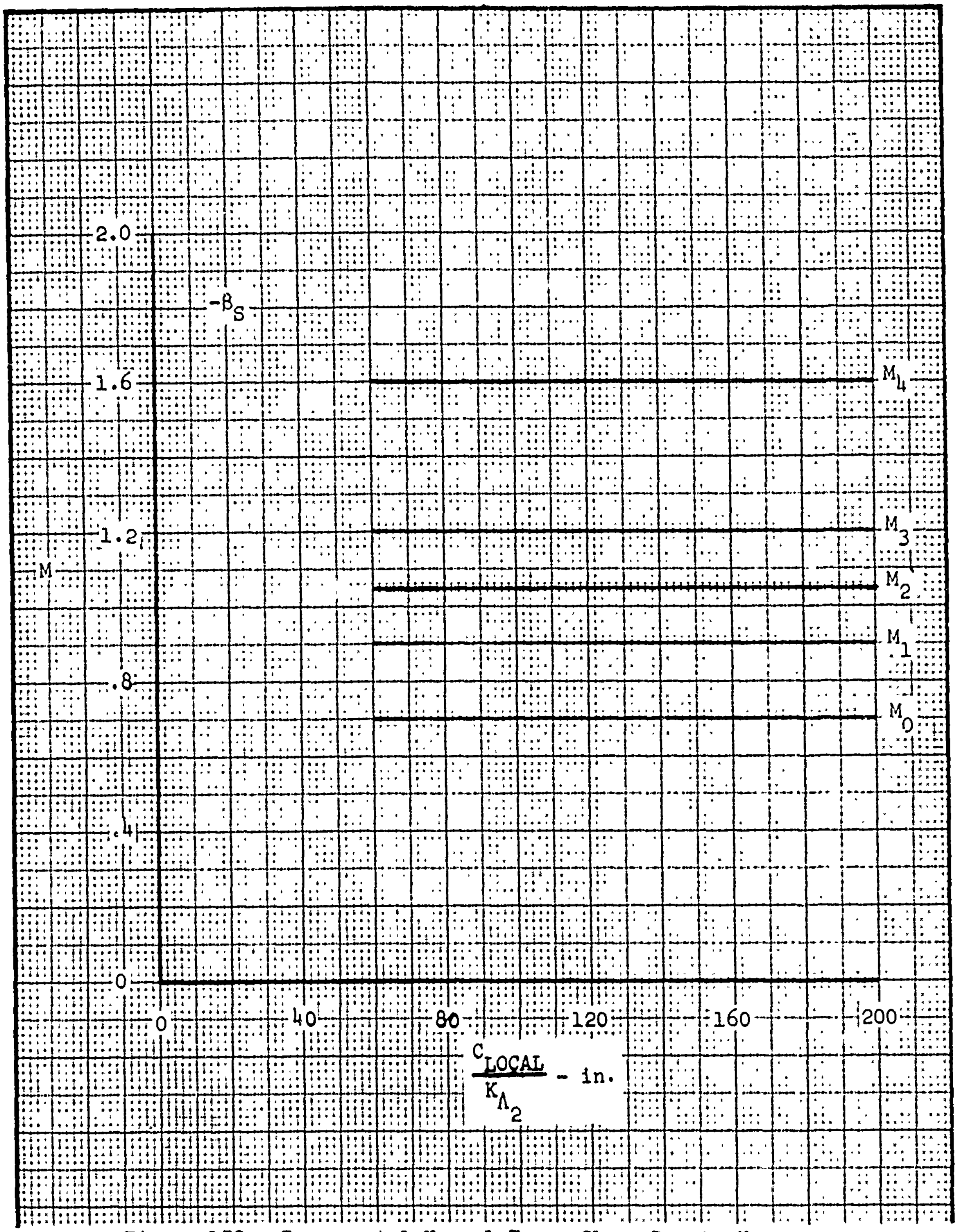

Figure 152. Incremental Normal Force Slope Due to Yaw - Mach Number Break Points for Negative Store Yaw

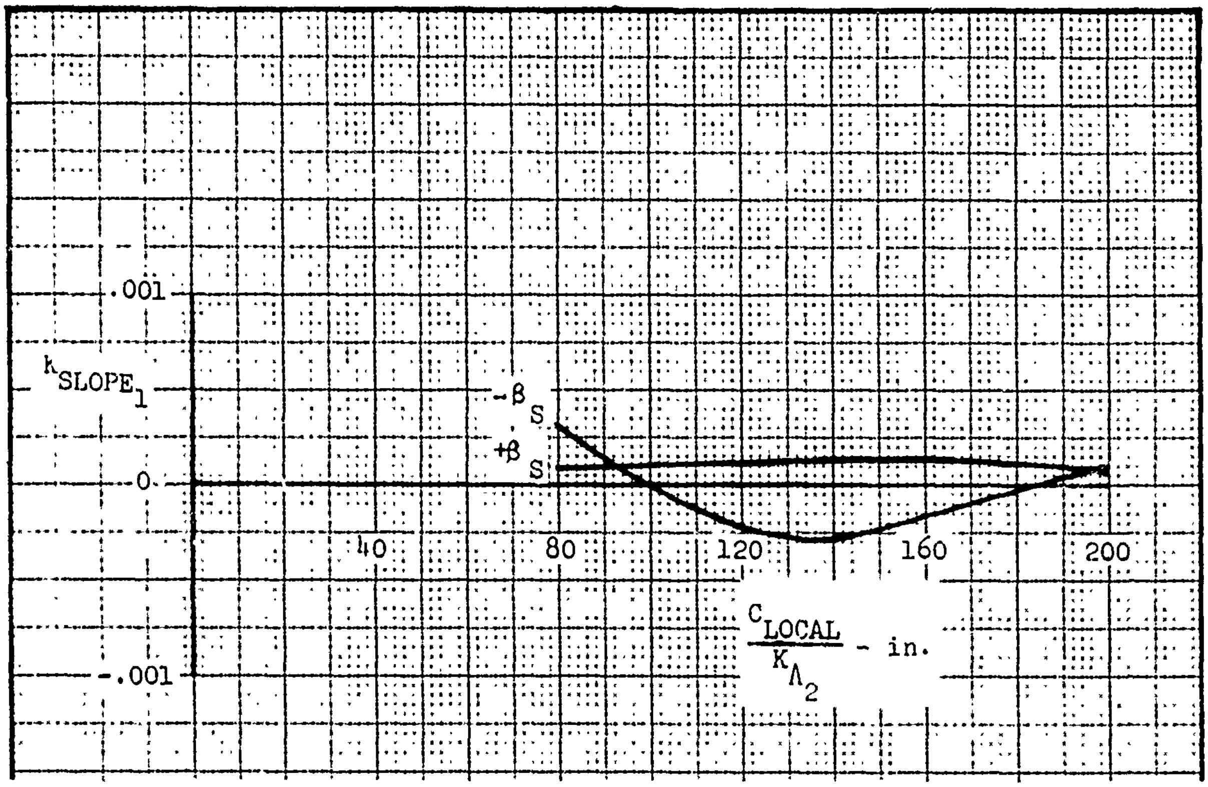

Figure 153. Incremental Normal Force Slope Due to Yaw - K_{SLOPE} for Mach Break 1

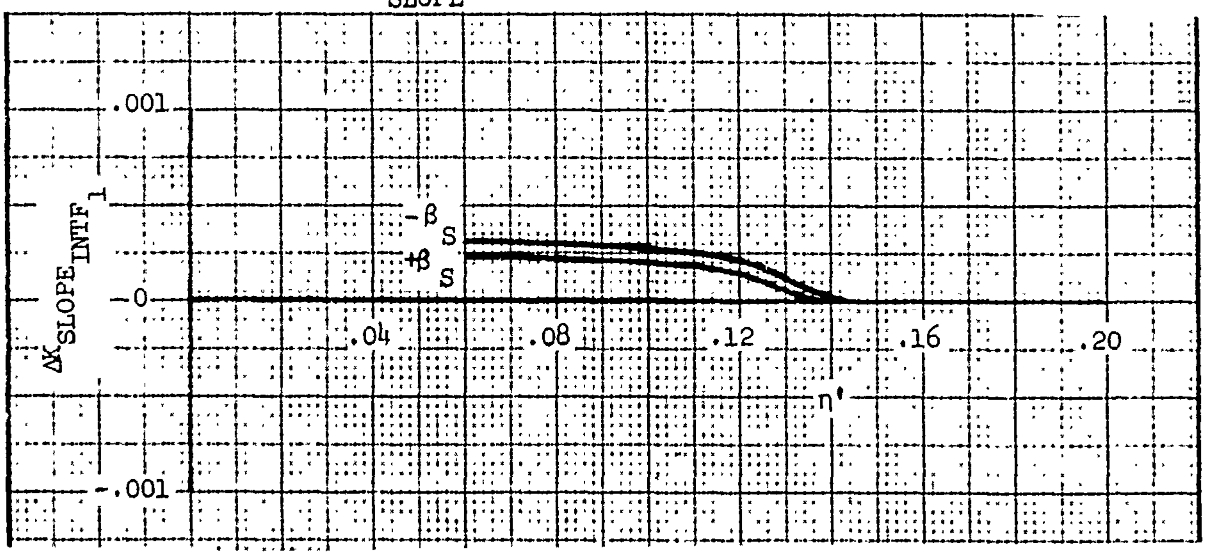

Figure 154. Incremental Normal Force Slope Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

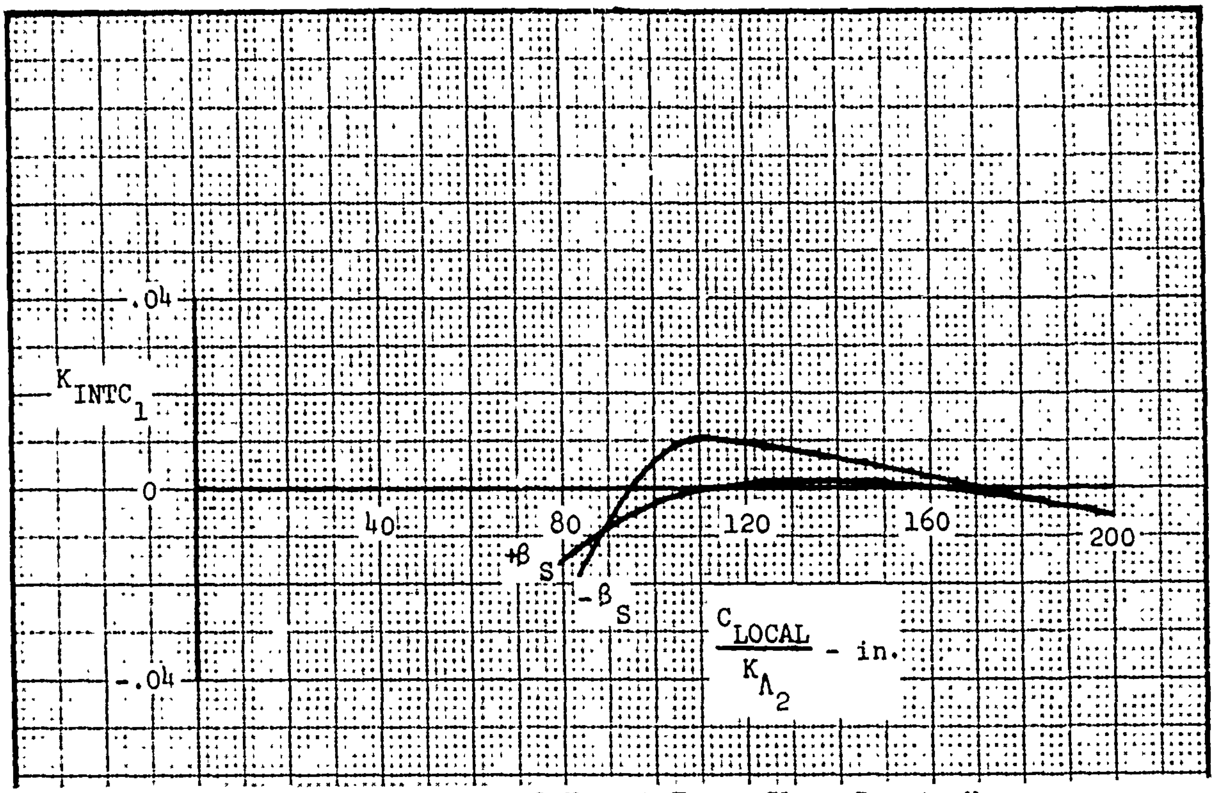

Figure 155. Incremental Normal Force Slope Due to Yaw- K_{INTC} for Mach Break 1

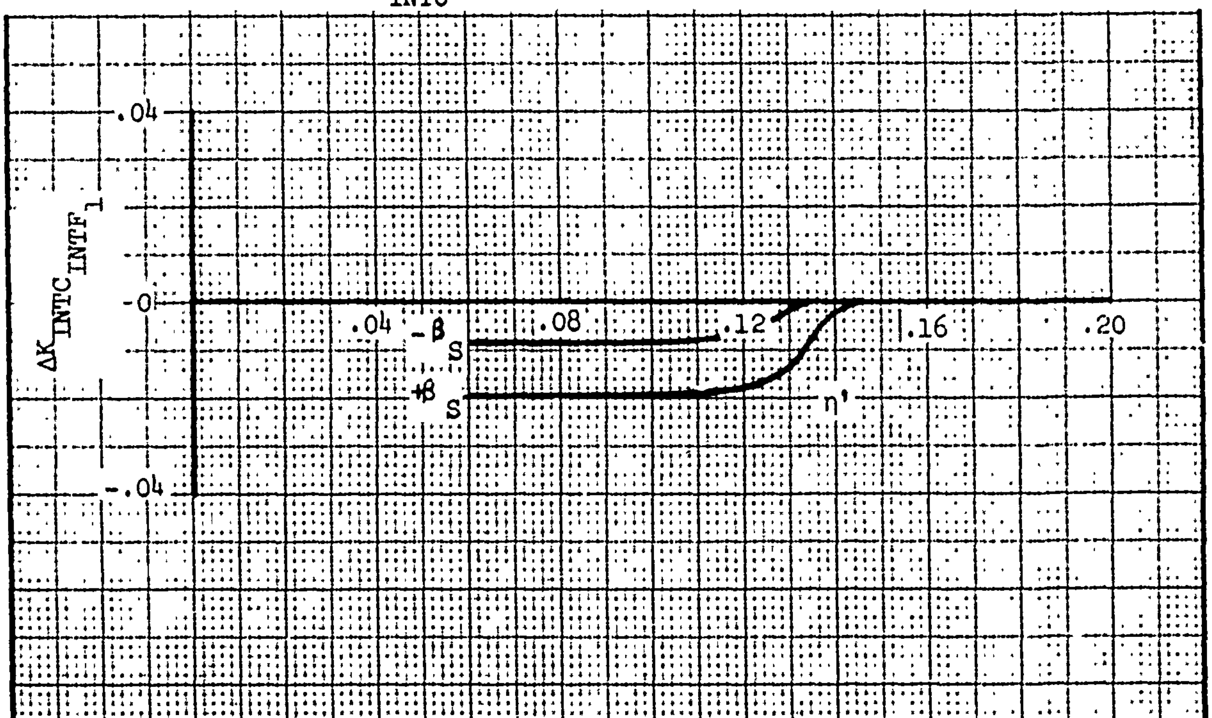

Figure 156. Incremental Normal Force Slope Due to Yaw - K_{INTC_1} Fuselage Interference Correction

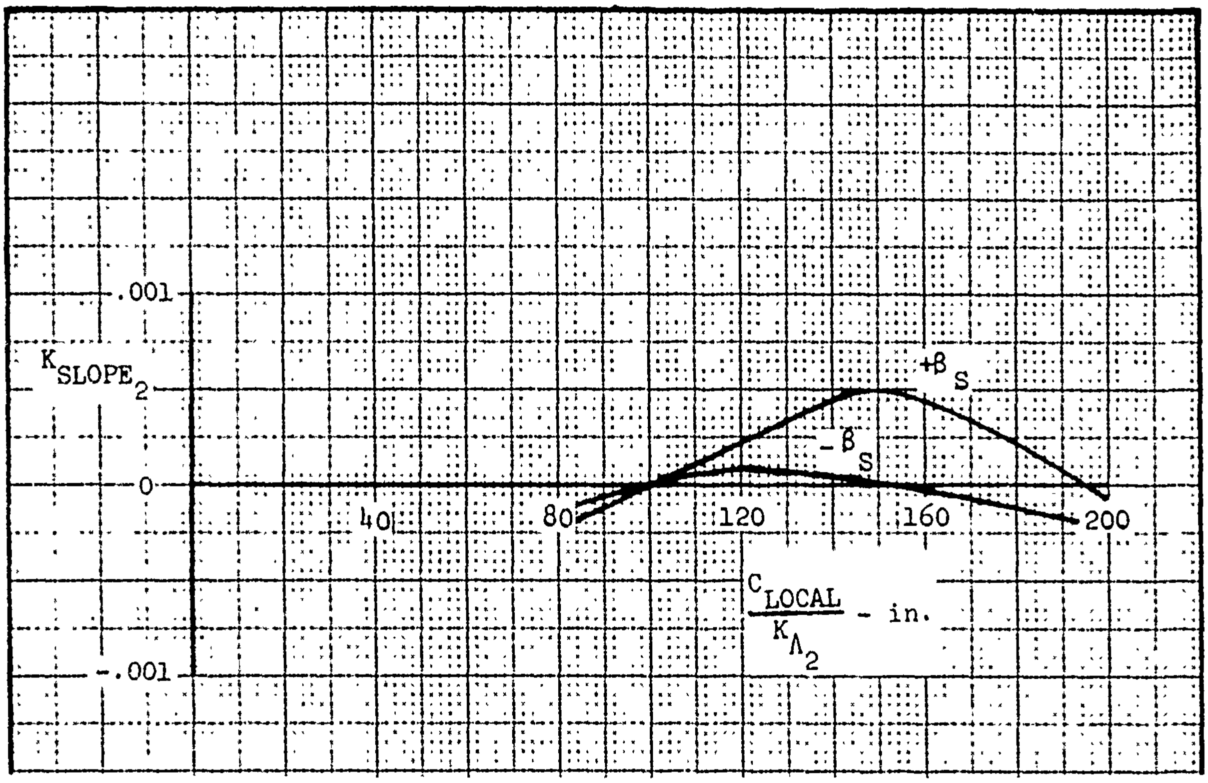

Figure 157. Incremental Normal Force Slope Due to Yaw - K_{SLOPE} for Mach Break 2

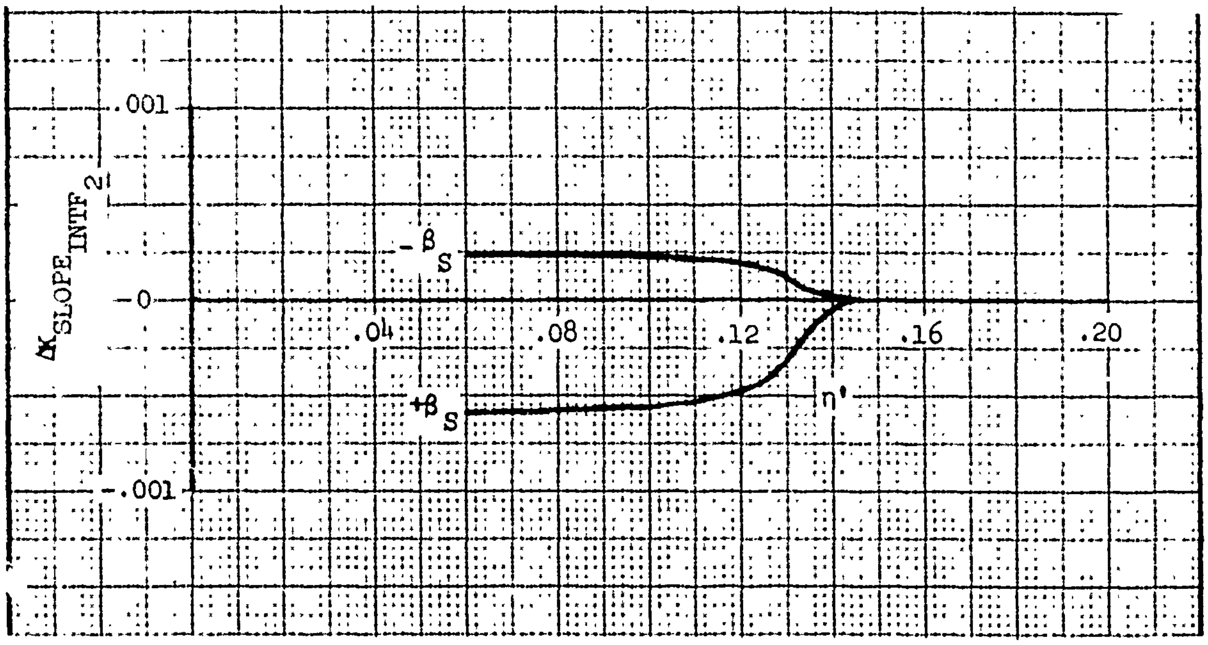

Figure 158. Incremental Normal Force Slope Due to Yaw - K_{SLOPE_2} Fuselage Interference Correction

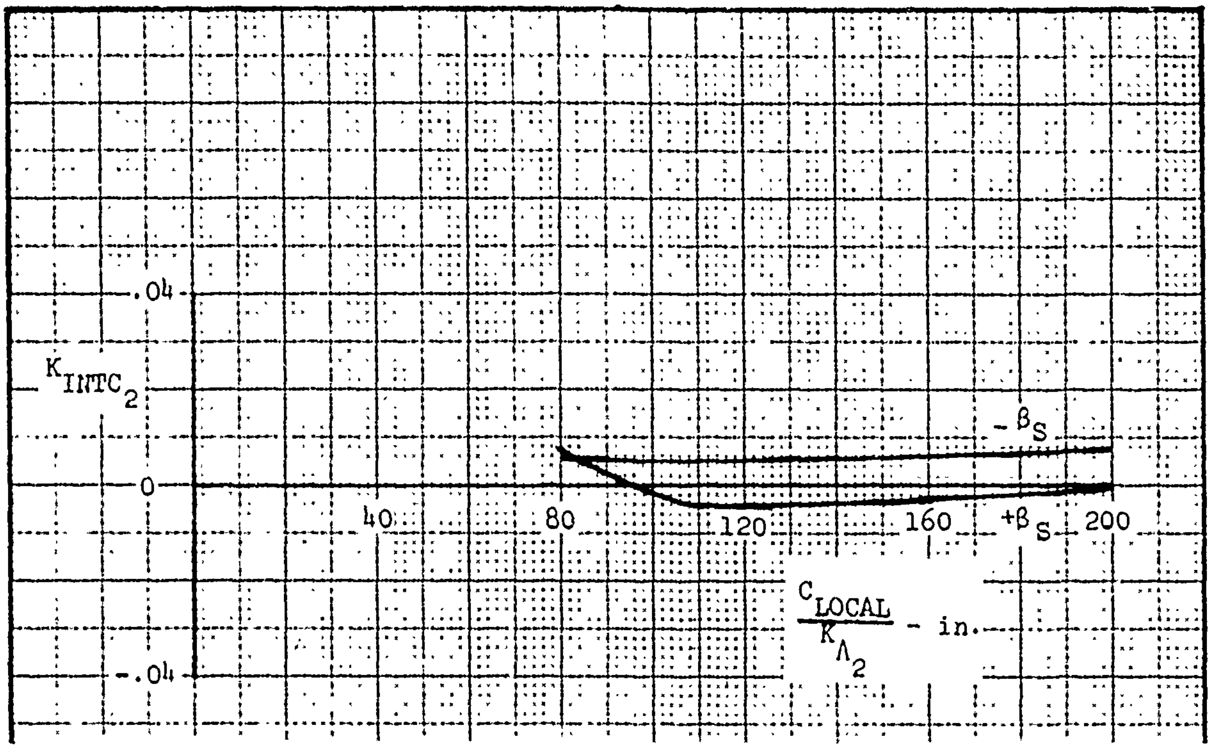

Figure 159. Incremental Normal Force Slope Due to Yaw - K_{INTC} for Mach Break 2

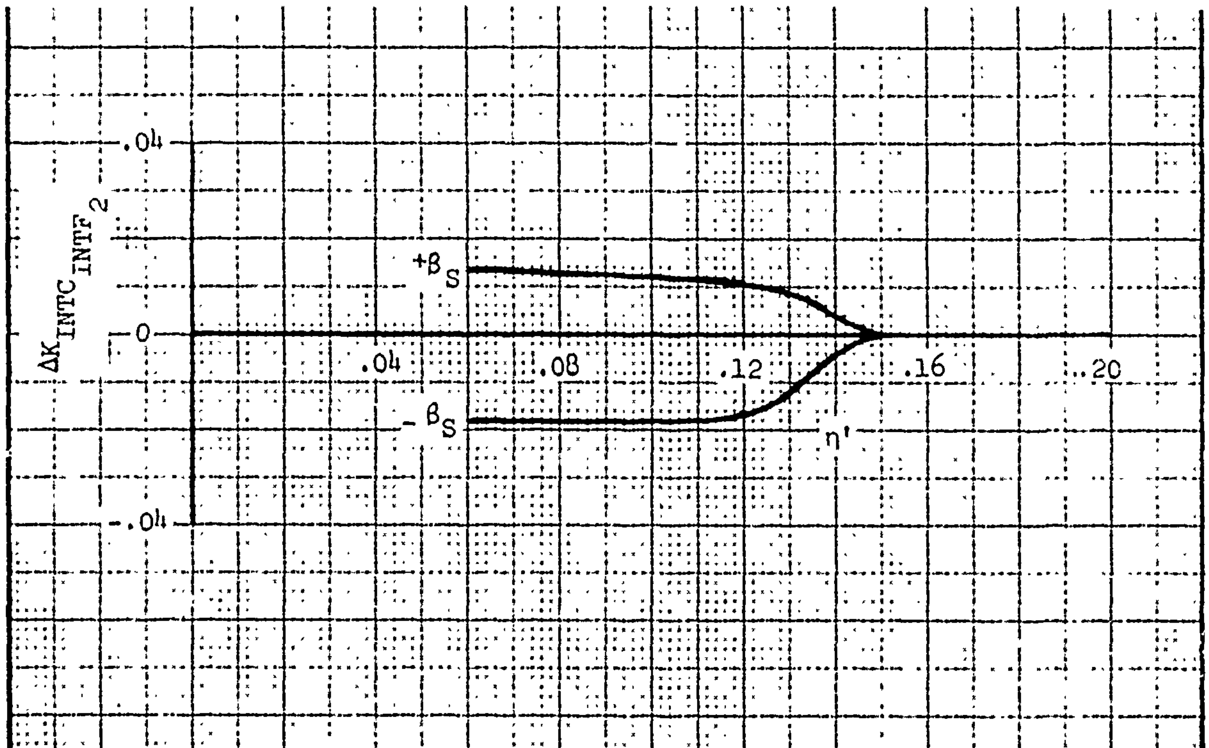

Figure 160. Incremental Normal Force Slope Due to Yaw - K_{INTC_2} Fuselage Interference Correction

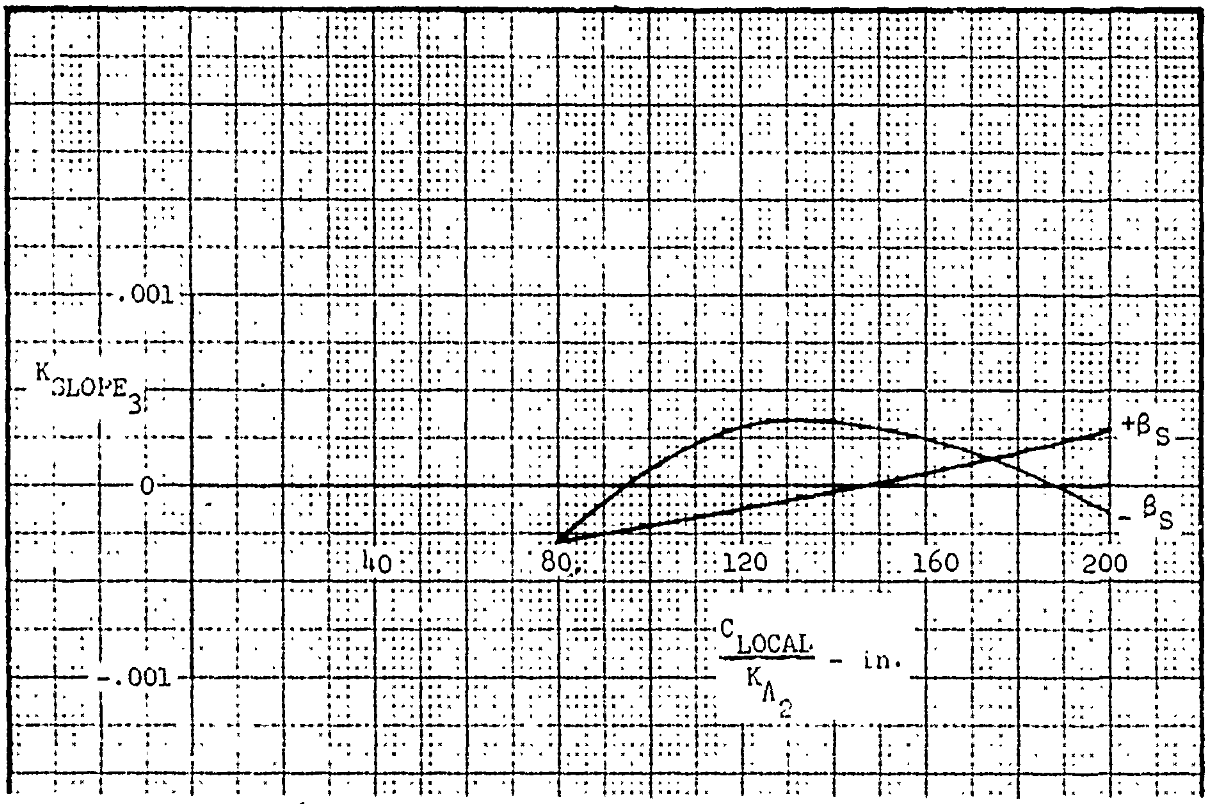

Figure 161. Incremental Normal Force Slope Due to Yaw - K_{SLOPE} for Mach Break 3

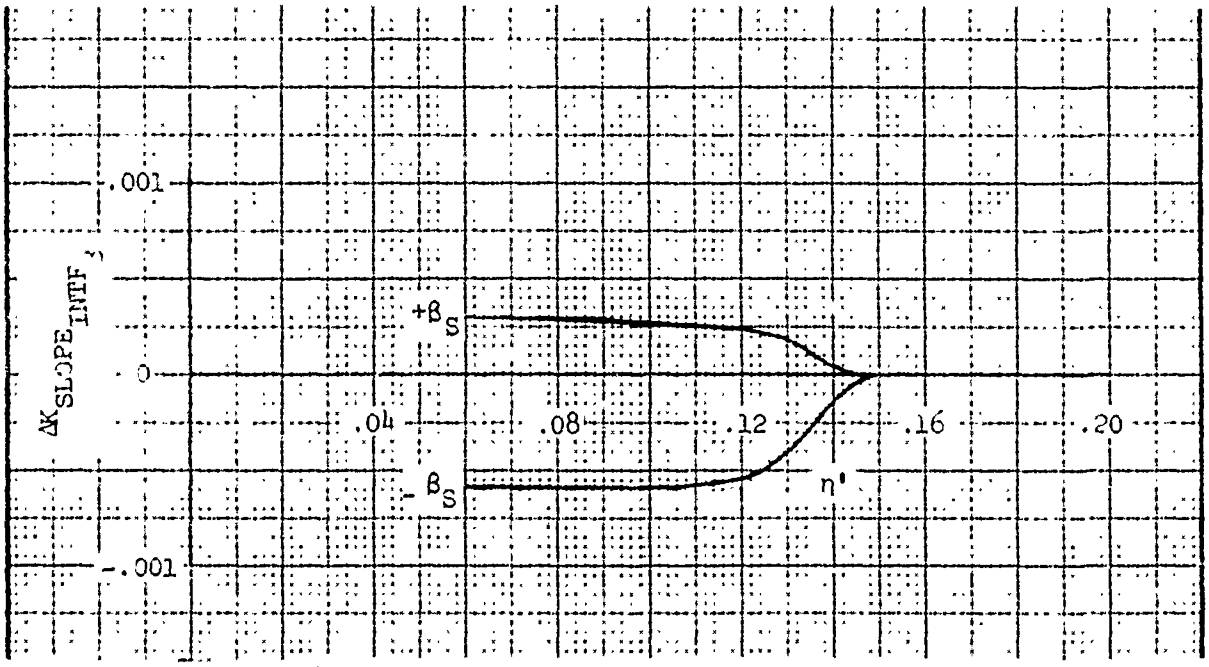

Figure 162. Incremental Normal Force Slope Due to Yaw - K_{SLOPE_3} Fuselage Interference Correction

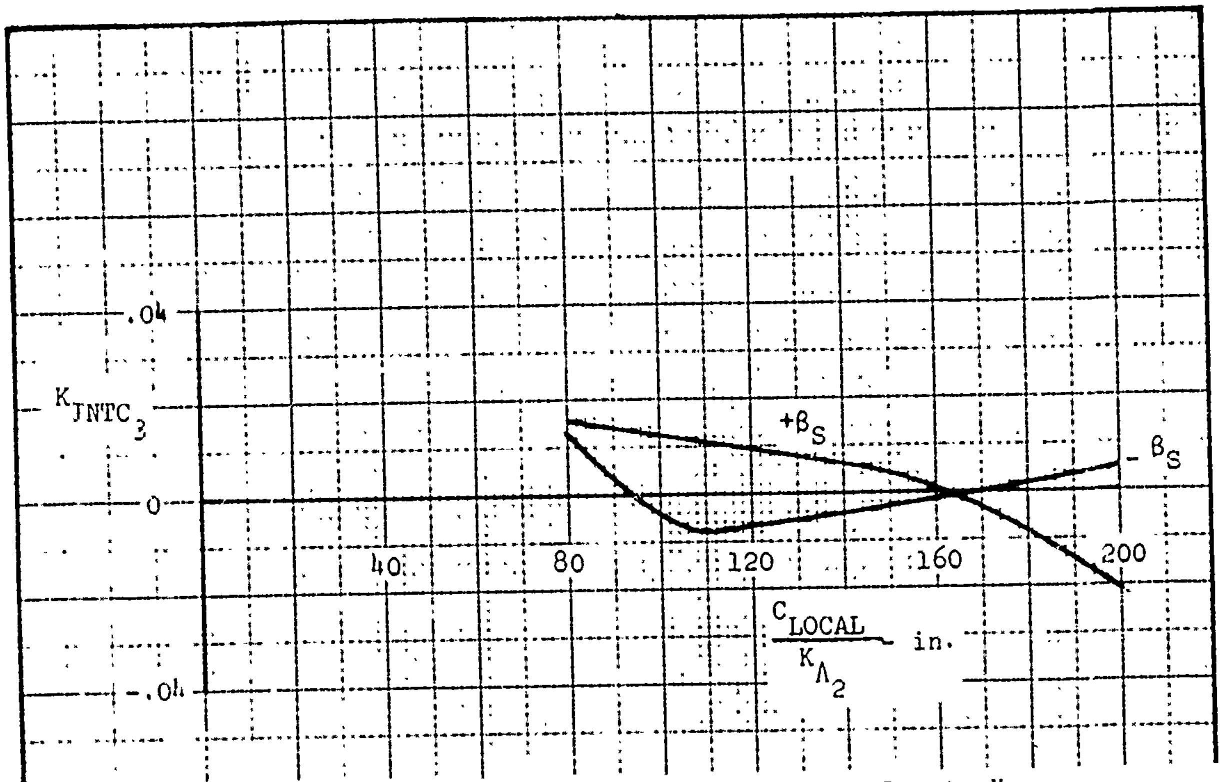

Figure 163. Incremental Normal Force Slope Due to Yaw - K_{INTC} for Mach Break 3

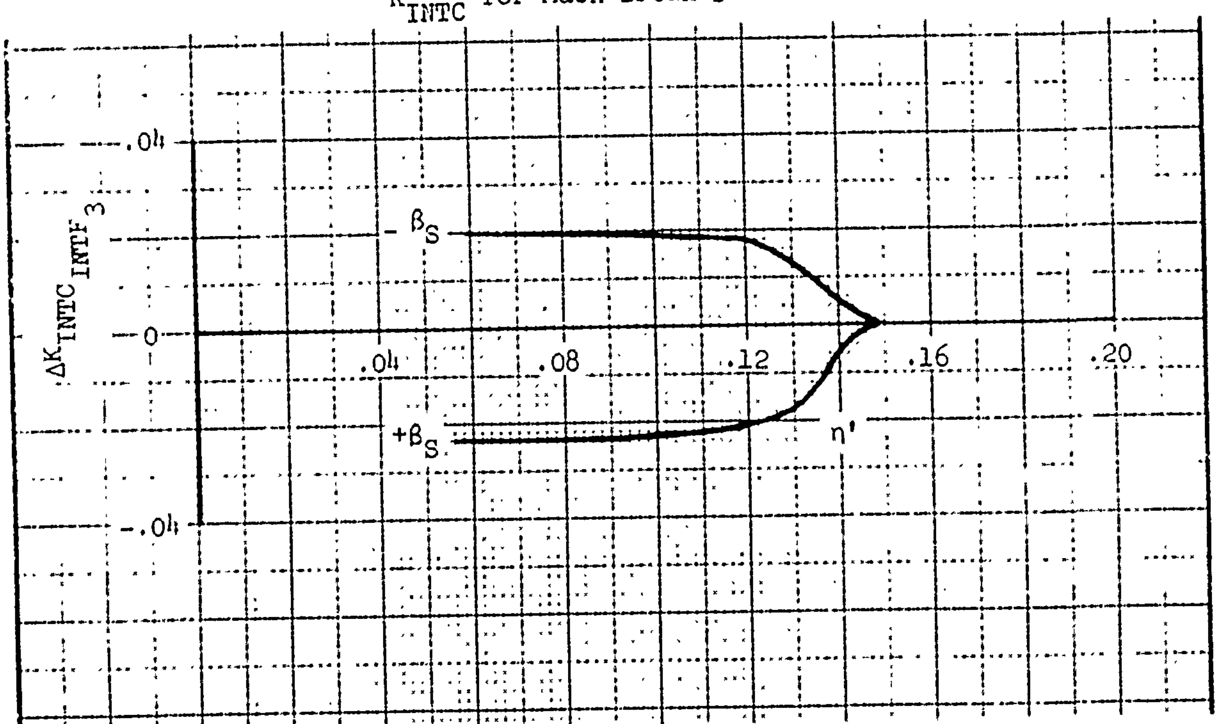

Figure 164. Incremental Normal Force Slope Due to Yaw - K_{INTC_3} Fuselage Interference Correction

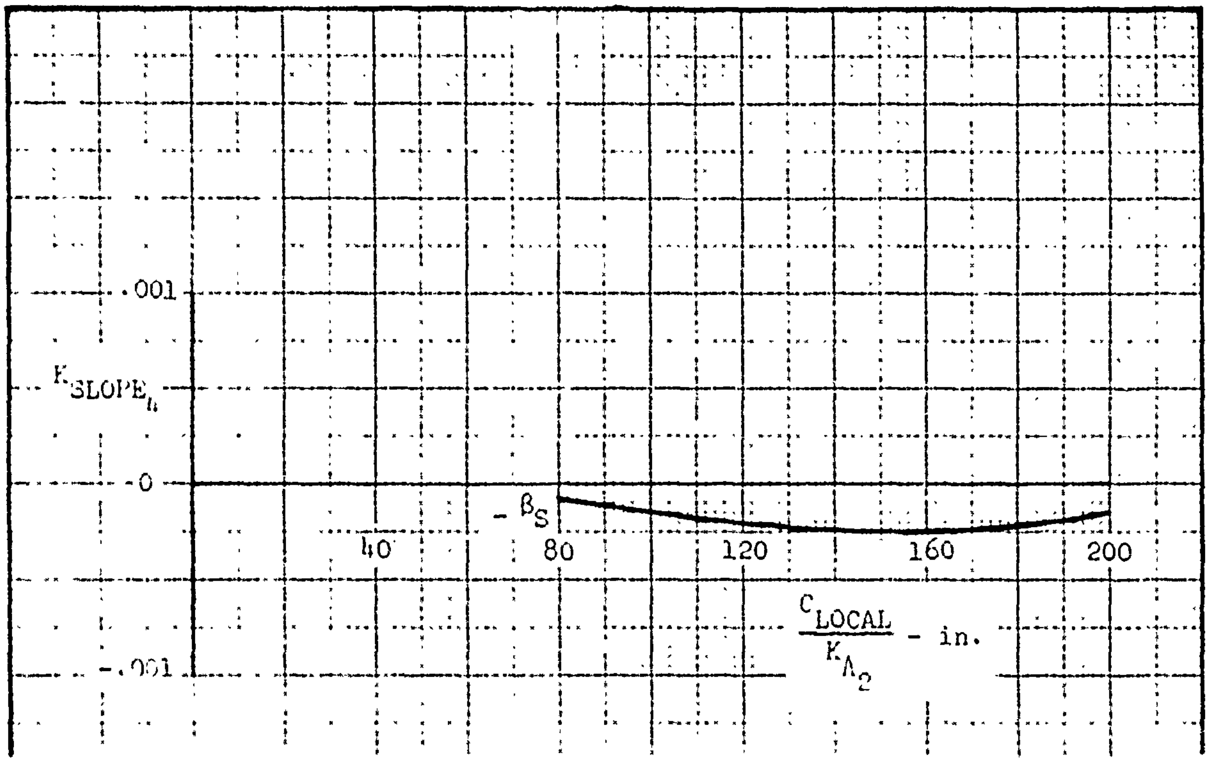

Figure 165. Incremental Normal Force Slope Due to Yaw - K_{SLOPE} for Mach Break 4

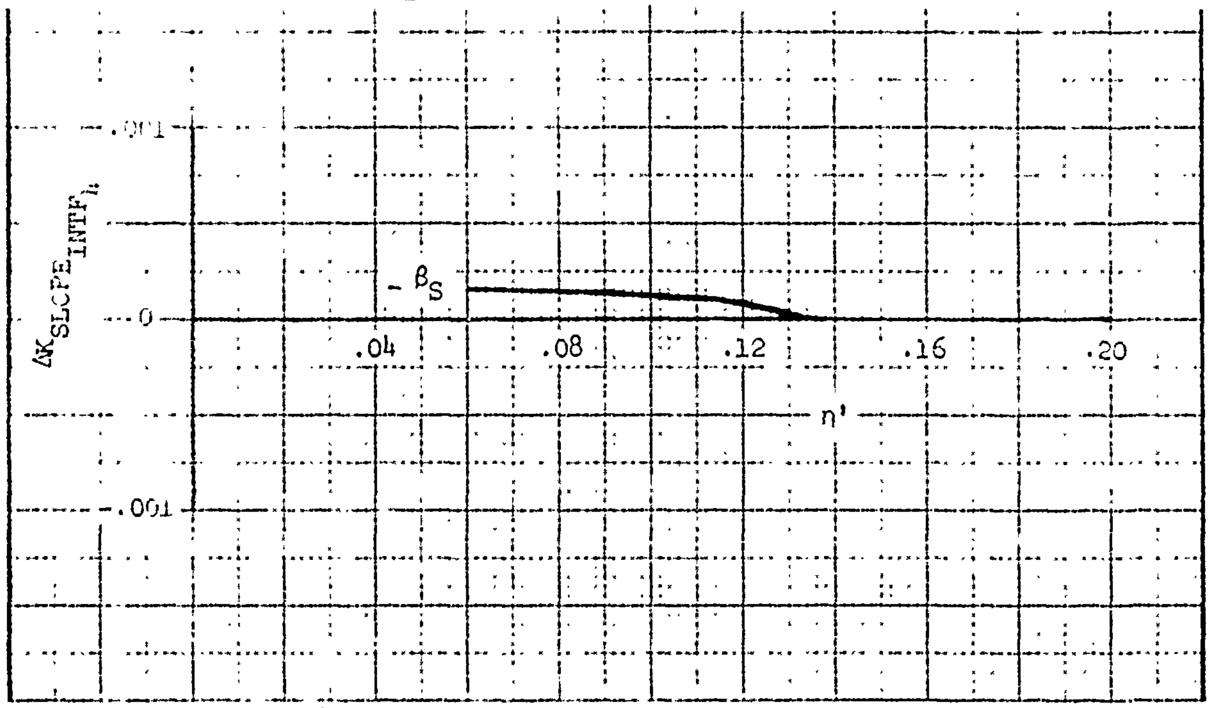

Figure 166. Incremental Normal Force Slope Due to Yaw- K_{SLOPE_4} Fuselage Interference Correction

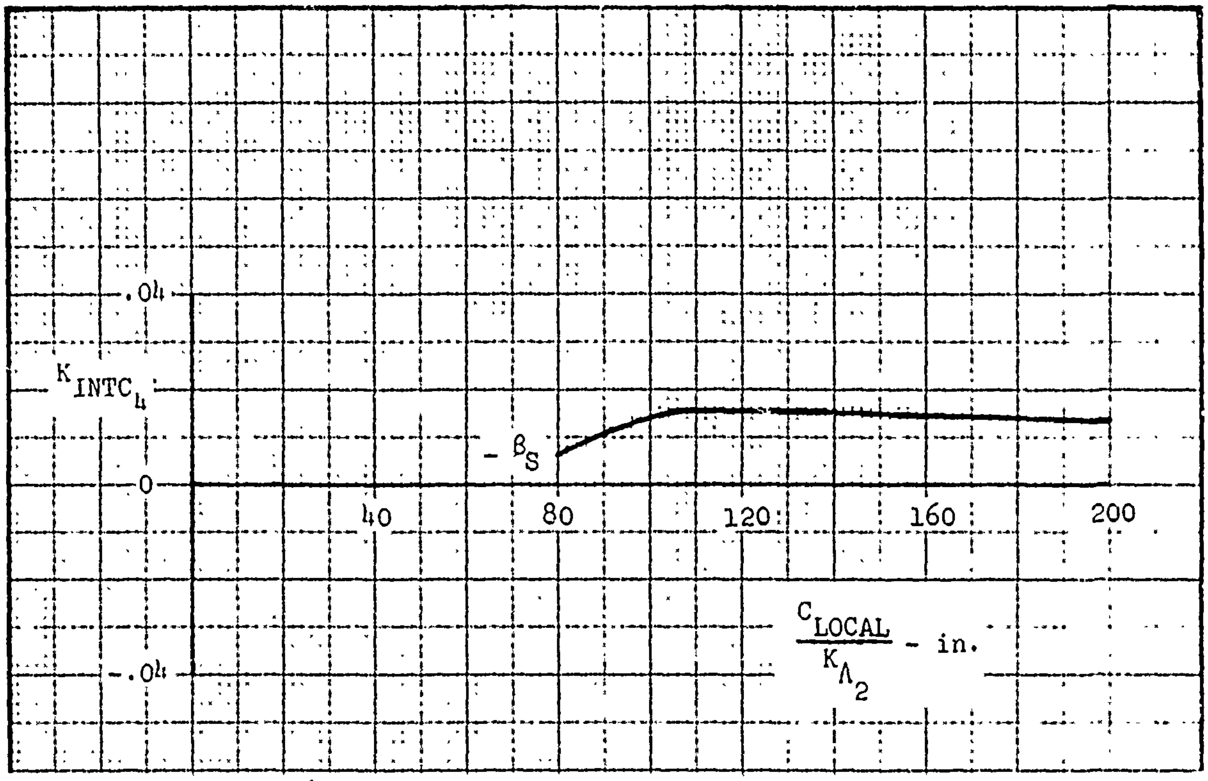

Figure 167. Incremental Normal Force Slope Due to Yaw - K_{INTC} for Mach Break 4

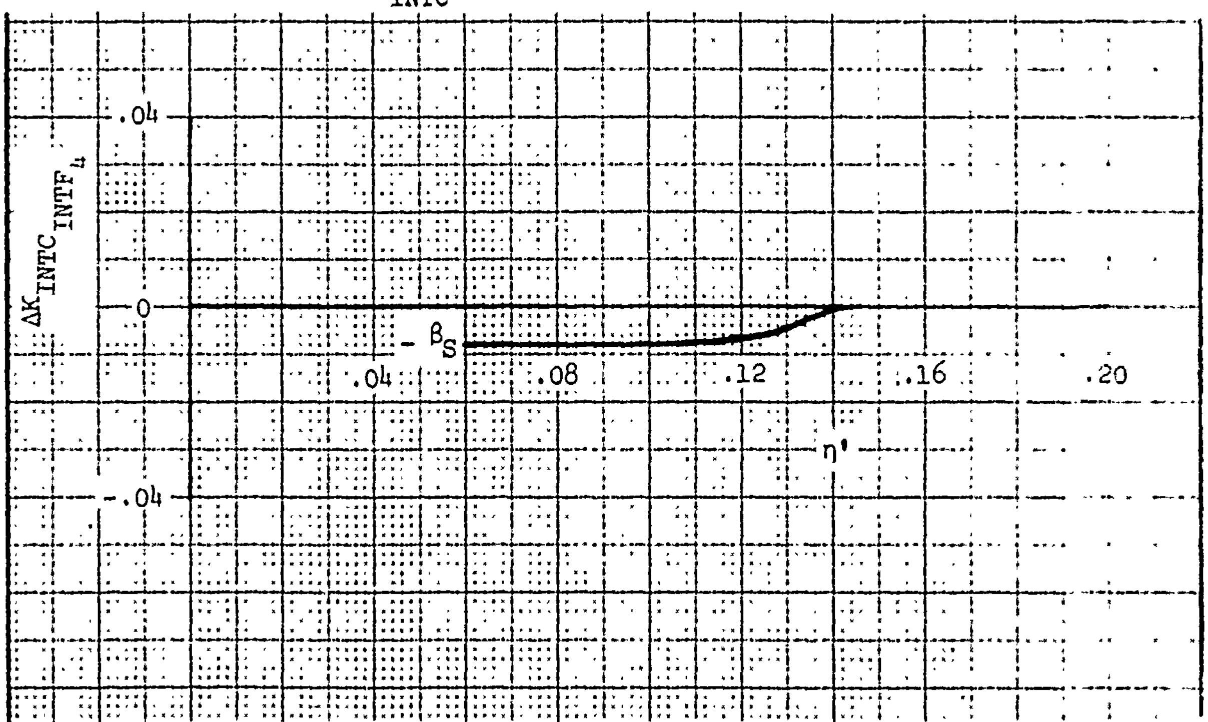

Figure 168. Incremental Normal Force Slope Due to Yaw - K_{INTC_4} Fuselage Interference Correction

3.3.2.3 Intercept Prediction

The equation for predicting the incremental normal force intercept per degree β_S, $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$, for M=0.5 is presented below.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_\eta} + \Delta K_{SLOPE_{INTF}})\, \ell_{LE} + K_{INTC_1} + \Delta K_{INTC_\eta} + \Delta K_{INTC_{INTF}}]\, S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental $C_{N_{\alpha=0}}$ per degree β_S with ℓ_{LE}, $\frac{1}{\text{in.-deg.}}$, Figure 169.

ΔK_{SLOPE_η} - Incremental change in K_{SLOPE_1} due to spanwise store location, $\frac{1}{\text{in.-deg.}}$, Figure 170.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{in.-deg.}}$, Figure 171.

K_{INTC_1} - Value of $\Delta C_{N_{\alpha=0_{\beta_S}}}$ when $\ell_{LE} = 0$, $\frac{1}{\text{deg}}$, Figure 172.

ΔK_{INTC_η} - Incremental change in K_{INTC_1} due to store spanwise location, $\frac{1}{\text{deg}}$, Figure 173.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{deg}}$, Figure 174.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}

Example:

Compute $\Delta\left(\frac{NF}{q}\right)_{\alpha=0}$ for a 300-gallon tank on the A-7 center pylon at M=0.5 and $\beta_S=4°$.

Required for Computation:

$S_{REF} = 3.83\ ft^2$

$\eta' = .27$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_2} = 1.158$

$\ell_{LE} = 75.1$ in.

$\eta = .418$

K_{SLOPE_1}	= -.0008	- Figure 169,	+ β_S curve
ΔK_{SLOPE_η}	= -.0010	- Figure 170,	+ β_S curve
$\Delta K_{SLOPE_{INTF}}$	= 0.0	- Figure 171,	+ β_S curve
K_{INTC_1}	= .080	- Figure 172,	+ β_S curve
ΔK_{INTC_η}	= .060	- Figure 173,	+ β_S curve
$\Delta K_{INTC_{INTF}}$	= 0.0	- Figure 174,	+ β_S curve

Substituting,

$$\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}} = [(-.0008 - .0010 + 0.0)\ (75.1) + .080 + .060 + 0.0]\ 3.83 = .0192\ \frac{ft^2}{deg}$$

and using the equation of Subsection 3.3.2,

$$\Delta\left(\frac{NF}{q}\right)_{\alpha=0} = \Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}} \cdot \beta_S$$

$$= (.0192)\ (4) = .0768\ ft^2$$

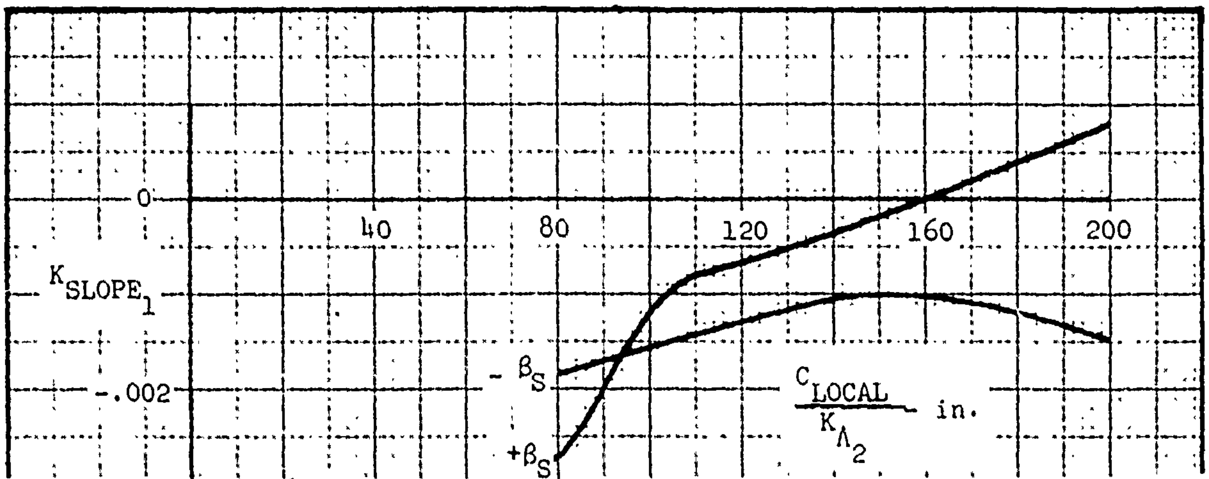

Figure 169. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

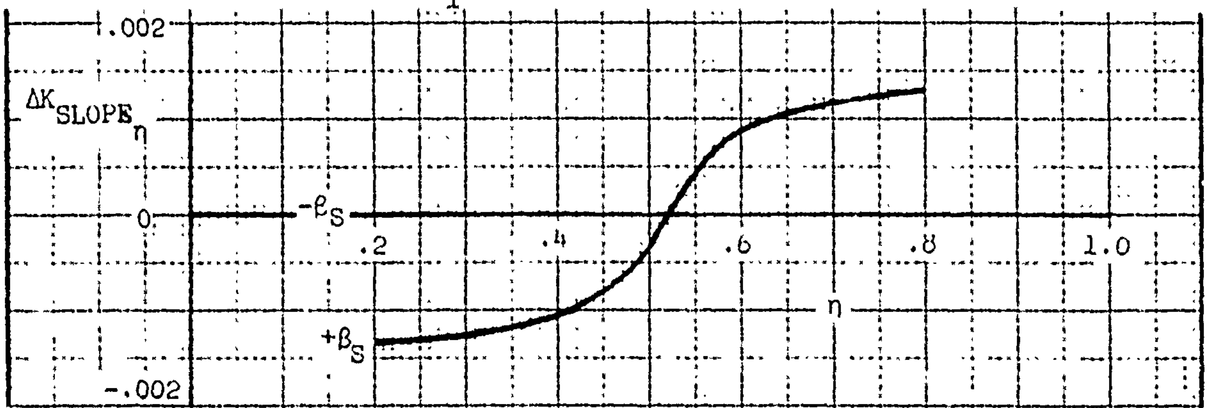

Figure 170. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_1} Spanwise Position Correction

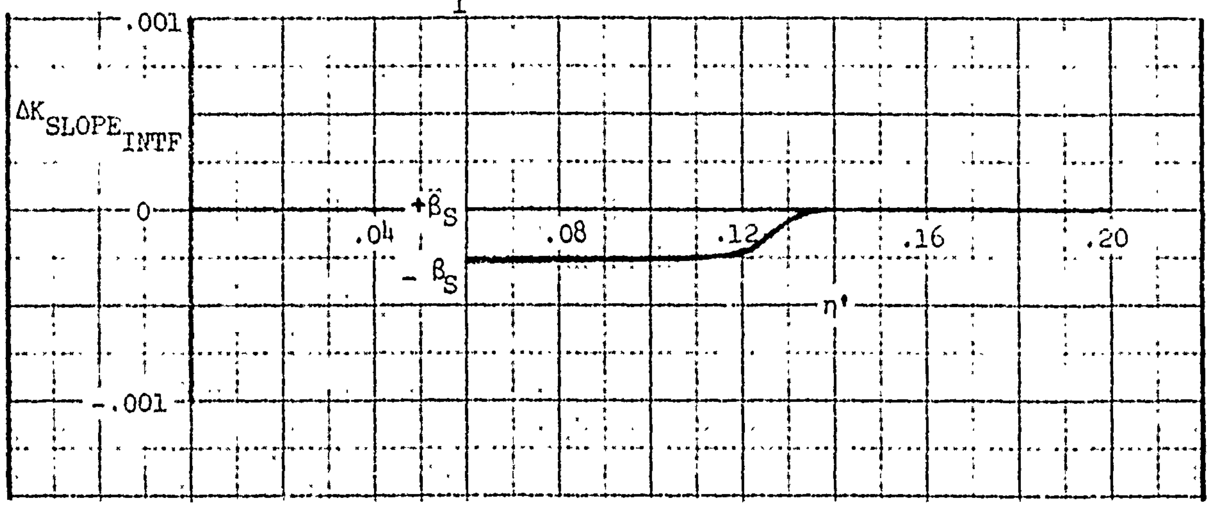

Figure 171. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

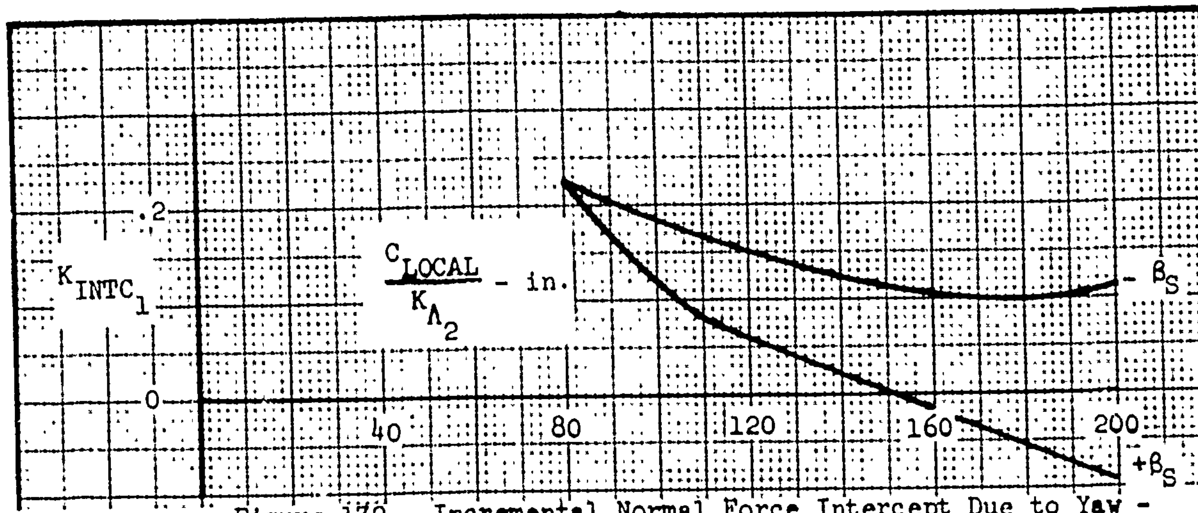

Figure 172. Incremental Normal Force Intercept Due to Yaw - K_{INTC_1} for Positive and Negative Store Yaw

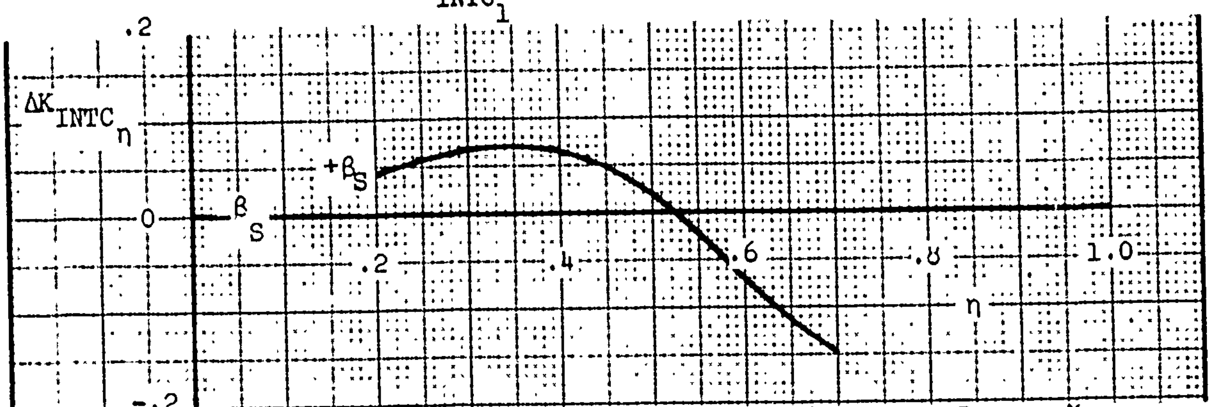

Figure 173. Incremental Normal Force Intercept Due to Yaw - K_{INTC_1} Spanwise Position Correction

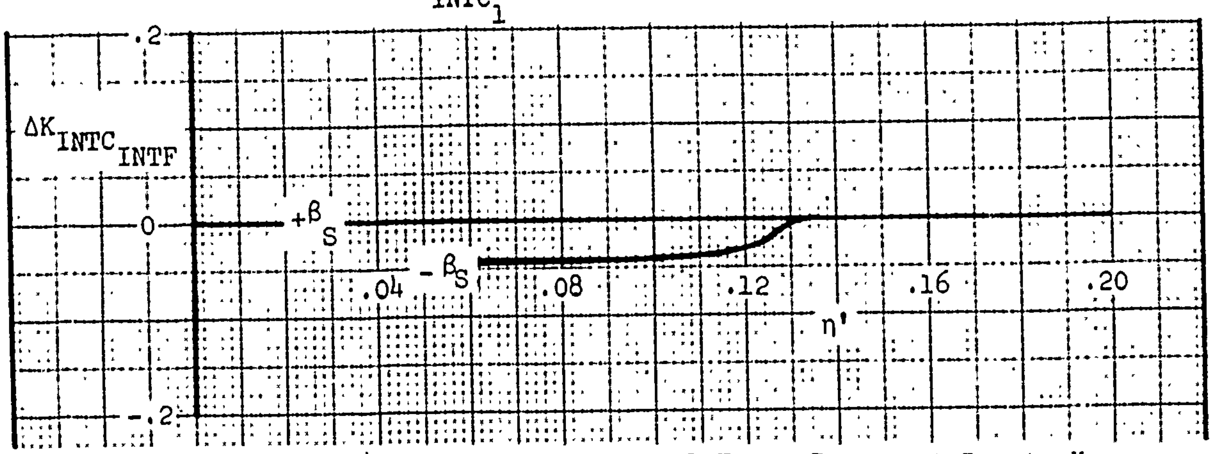

Figure 174. Incremental Normal Force Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

3.3.2.4 Intercept Mach Number Correction

The procedure for calculating the Mach number correction for incremental normal force intercept is similar to that presented in Subsection 3.3.2.2 for incremental normal force slope Mach number correction.

The incremental normal force intercept variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_o, M_1, M_2, M_3, and M_4 as in Figure 175.

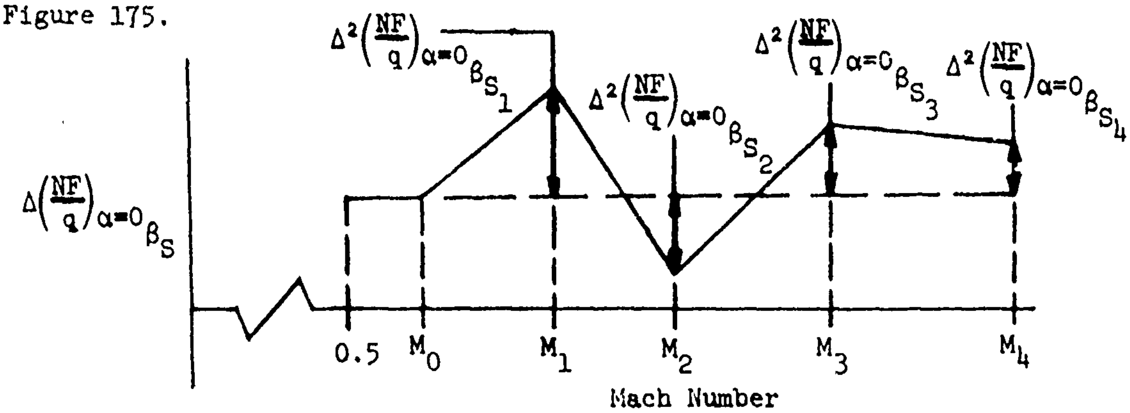

Figure 175. Incremental Normal Force Intercept Due to Yaw - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figures 176 and 177 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_o is the Mach number where the intercept initially deviates from the value predicted at M=0.5. Equations have been developed to predict the incremental change at each of the remaining Mach break points. The equations are as follows:

Break 1 (M_1):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_1}}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF_1}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF_1}}]\, S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental $C_{N_{\alpha=0_1}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{\text{in.-deg.}}$, Figure 178.

$\Delta K_{SLOPE_{INTF_1}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{in.-deg.}}$, Figure 179.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2

K_{INTC_1} - Value of $\Delta C_{N_{\alpha=0}}{}_{\beta_{S_1}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 180.

$\Delta K_{INTC_{INTF_1}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 181.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}

Break 2 (M_2):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_2}}} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF_2}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2} + \Delta K_{INTC_{INTF_2}}]\ S_{REF}$$

where:

K_{SLOPE_2} - Variation of incremental $C_{N_{\alpha=0_2}}$, per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.-deg.}$, Figure 182.

$\Delta K_{SLOPE_{INTF_2}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in.-deg.}$, Figure 183.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2.

K_{INTC_2} - Value of $\Delta C_{N_{\alpha=0}}{}_{\beta_{S_2}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 184.

$\Delta K_{INTC_{INTF_2}}$ - Incremental change in K_{INTC_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 185.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}

Break 3 (M_3):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_3}}} = [(K_{SLOPE_3} + \Delta K_{SLOPE_{INTF_3}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_3} + \Delta K_{INTC_{INTF_3}}]\, S_{REF}$$

where:

K_{SLOPE_3} - Variation of incremental $C_{N_{\alpha=0_3}}$, per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.-deg.}$, Figure 186.

$\Delta K_{SLOPE_{INTF_3}}$ - Incremental change in K_{SLOPE_3} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in.-deg.}$, Figure 187.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2.

K_{INTC_3} - Value of $\Delta C_{N_{\alpha=0_{\beta_3}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 188.

$\Delta K_{INTC_{INTF_3}}$ - Incremental change in K_{INTC_3} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 189.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}

Break 4 (M_4):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_4}}} = [(K_{SLOPE_4} + \Delta K_{SLOPE_{INTF_4}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4} + \Delta K_{INTC_{INTF_4}}]\, S_{REF}$$

where:

K_{SLOPE_4} - Variation of incremental $C_{N_{\alpha=0_4}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.-deg.}$, Figure 190.

$\Delta K_{SLOPE_{INTF_4}}$ - Incremental change in K_{SLOPE_4} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in.-deg.}$, Figure 191.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2.

K_{INTC_4} - Value of $\Delta C_{N_{\alpha=0_{\beta_{S_4}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 192.

$\Delta K_{INTC_{INTF_4}}$ - Incremental change in K_{INTC_4} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 193.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}.

To compute $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$ at M=x, first determine from Figure 176 or 177 between which Mach number break points M=x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$ at M=x from the following relation.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_{M=x}}}} = \Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_{M_{LOW}}}}} + \left(\frac{x - M_{LOW}}{M_{HI}-M_{LOW}}\right)\left[\Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_{M_{HI}}}}} - \Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_{S_{M_{LOW}}}}}\right]$$

If $x > M = 1.6$, $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$ at $M = x$ will be equal to the value of $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$ at $M = 1.6$

If $x \leq M_o$, $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$ at $M = x$ will be equal to the value of $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{\beta_S}}$ at $M = 0.5$ (the initial term in the above equation from Subsection 3.3.2.3).

A numerical example is found in Subsection 3.2.2.2 that illustrates the use of the above equation.

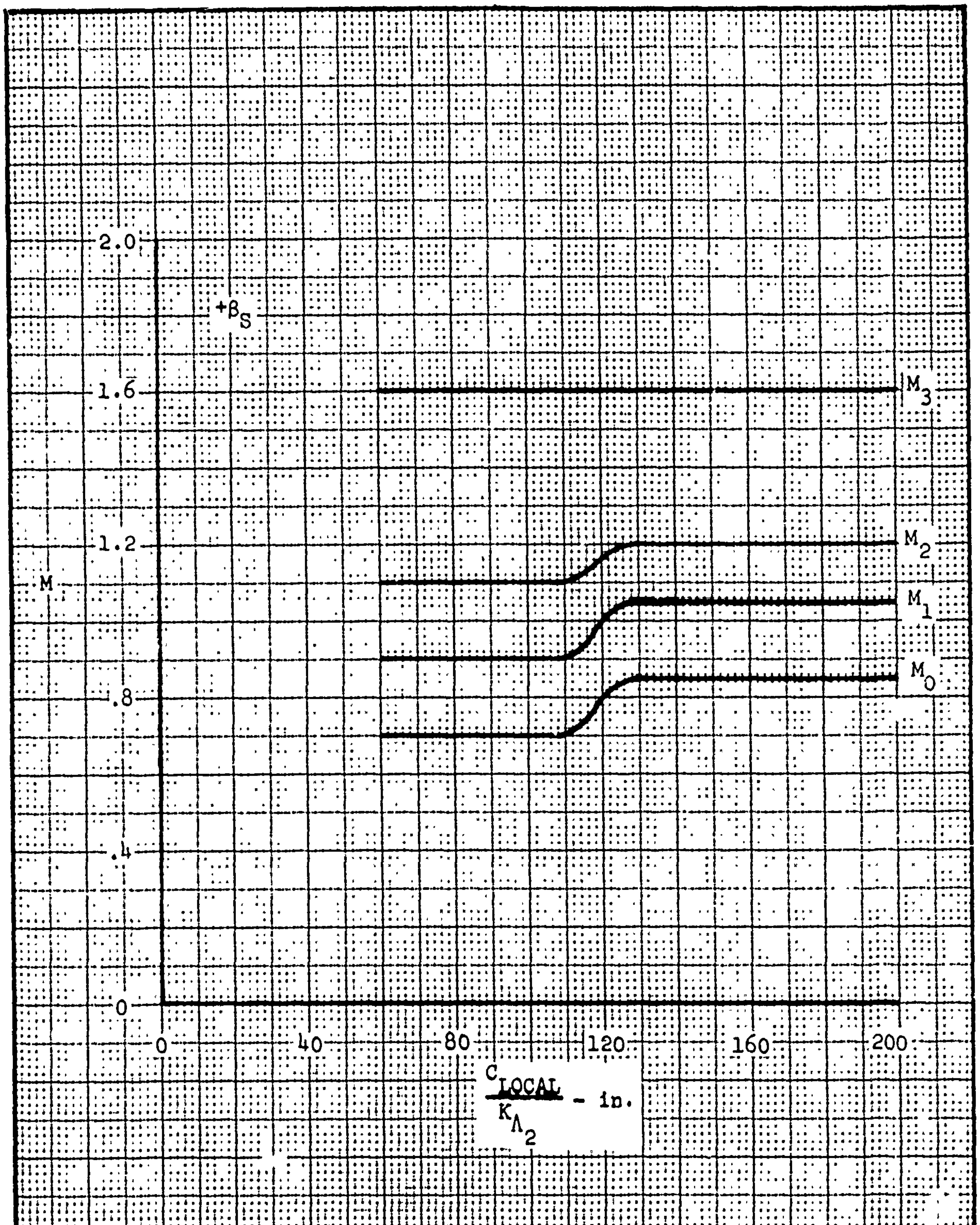

Figure 176. Incremental Normal Force Intercept Due to Yaw - Mach Number Break Points for Positive Store Yaw

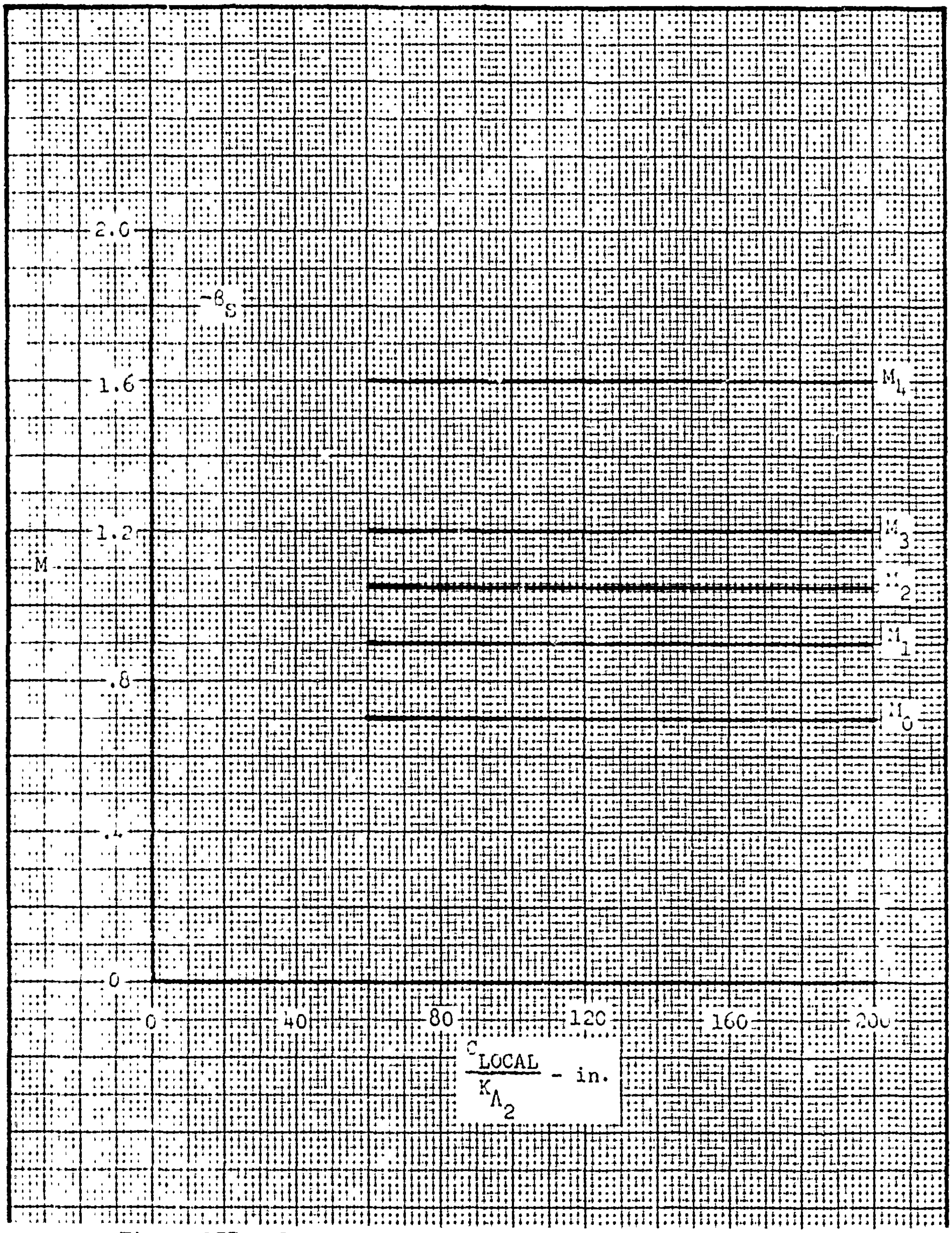

Figure 177. Incremental Normal Force Intercept Due to Yaw - Mach Number Break Points for Negative Store Yaw

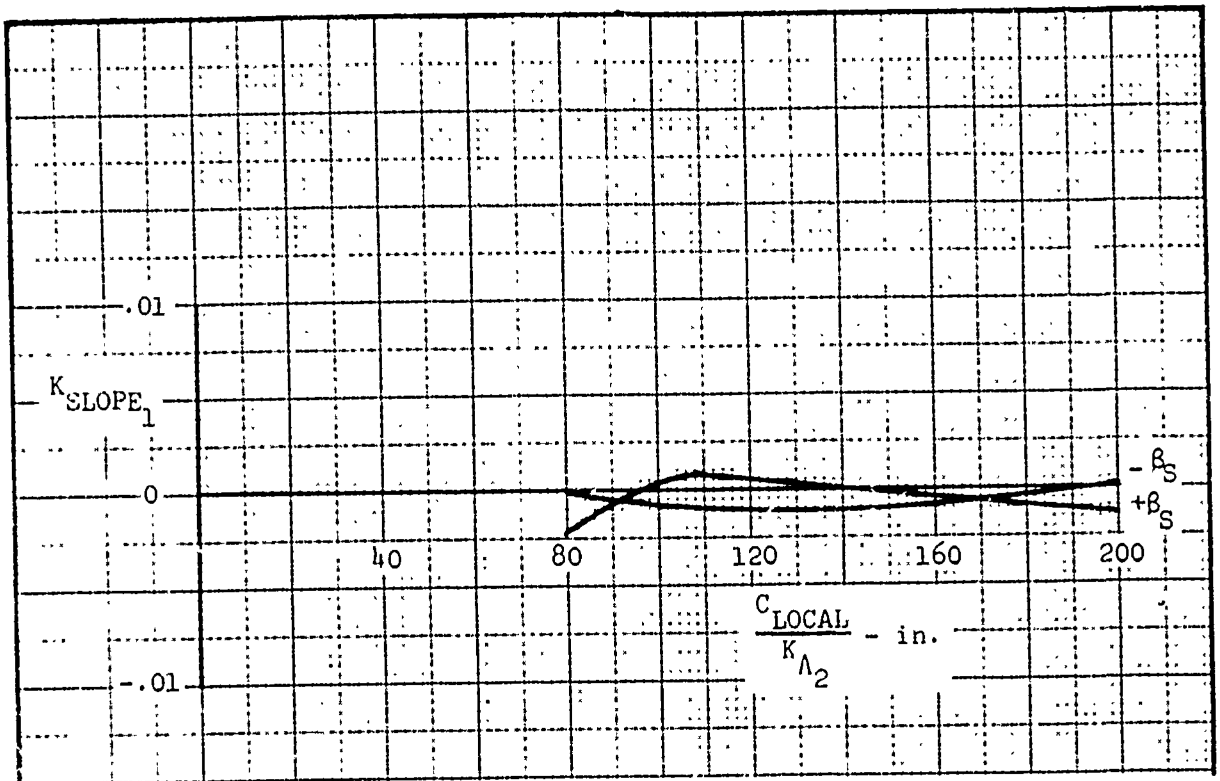

Figure 178. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE} for Mach Break 1

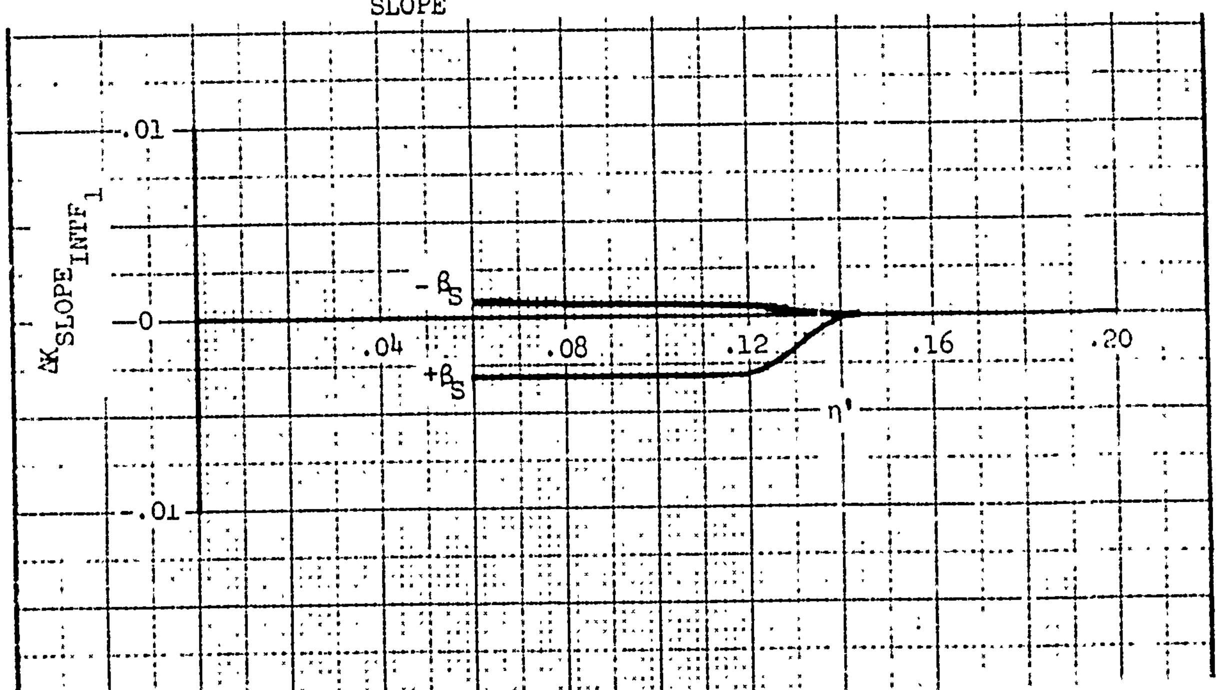

Figure 179. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

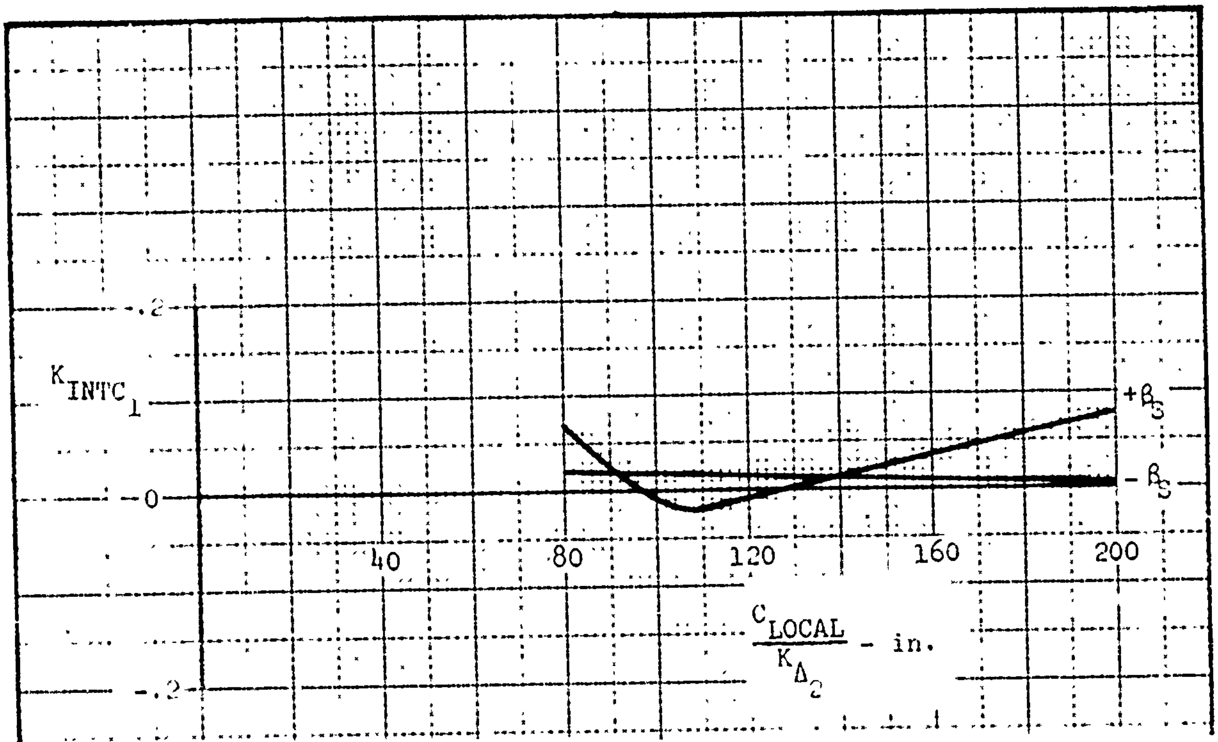

Figure 180. Incremental Normal Force Intercept Due to Yaw - K_{INTC} for Mach Break 1

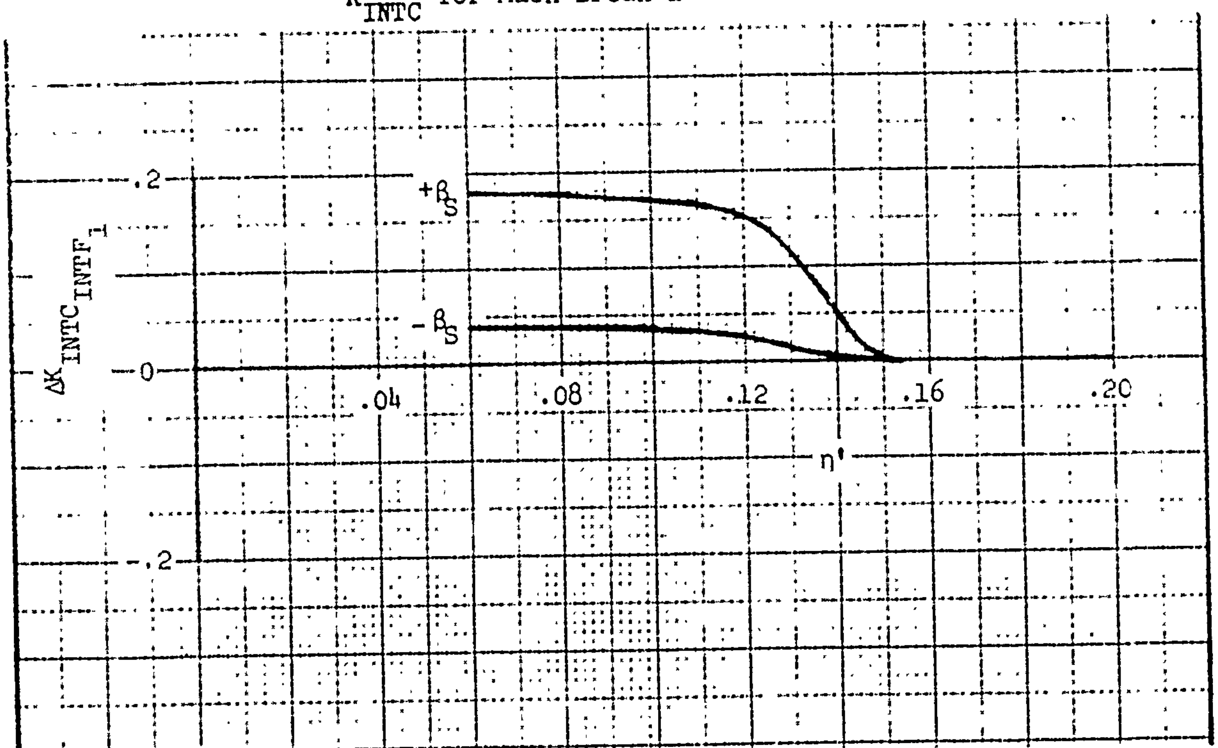

Figure 181. Incremental Normal Force Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

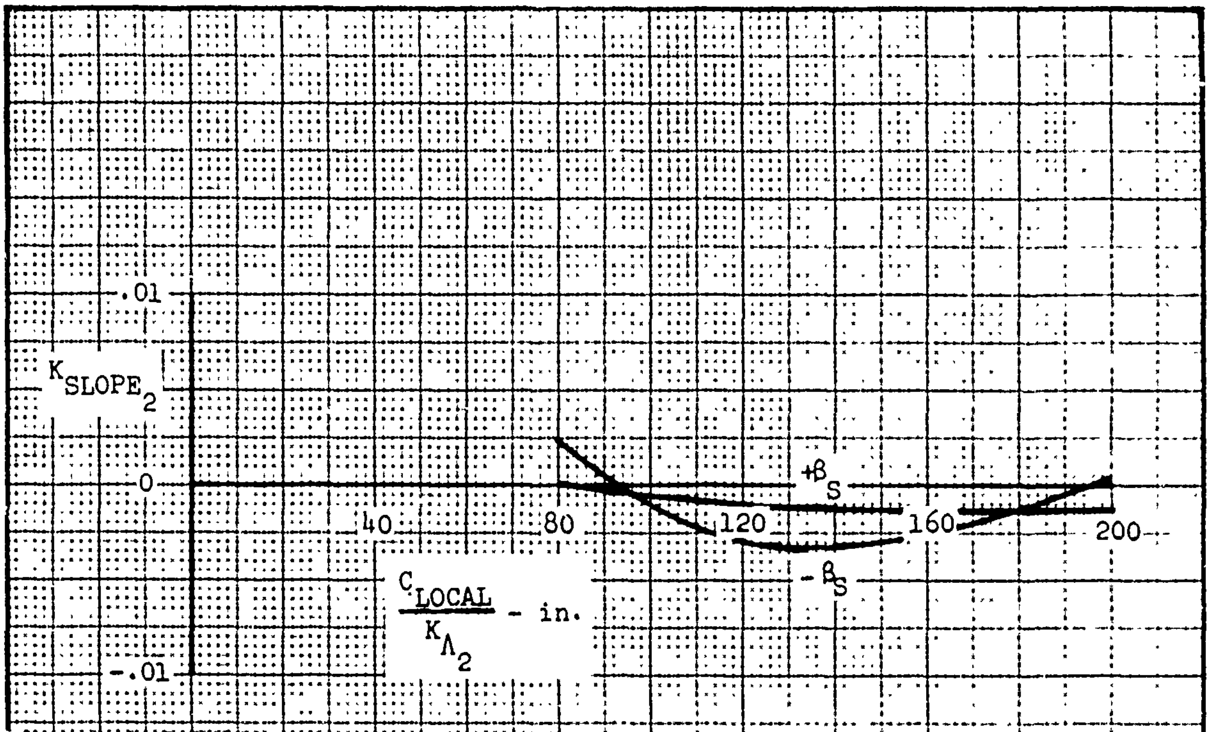

Figure 182. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE} for Mach Break 2

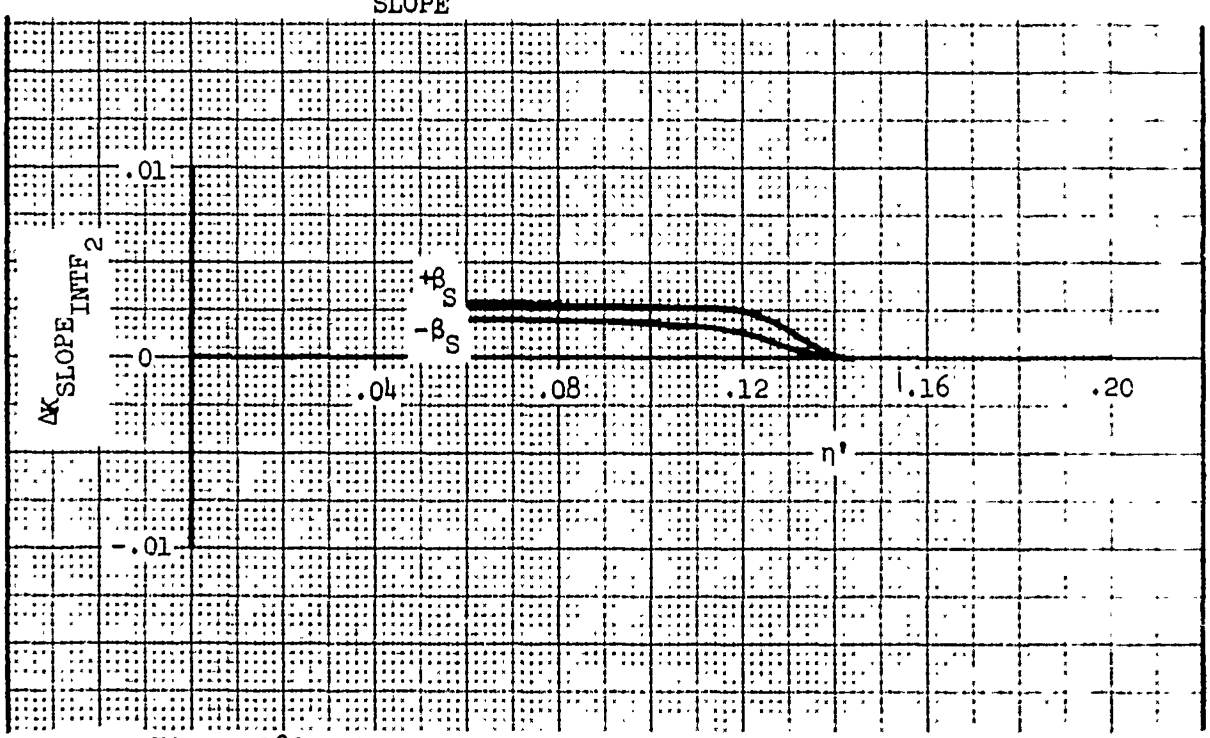

Figure 183. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_2} Fuselage Interference Correction

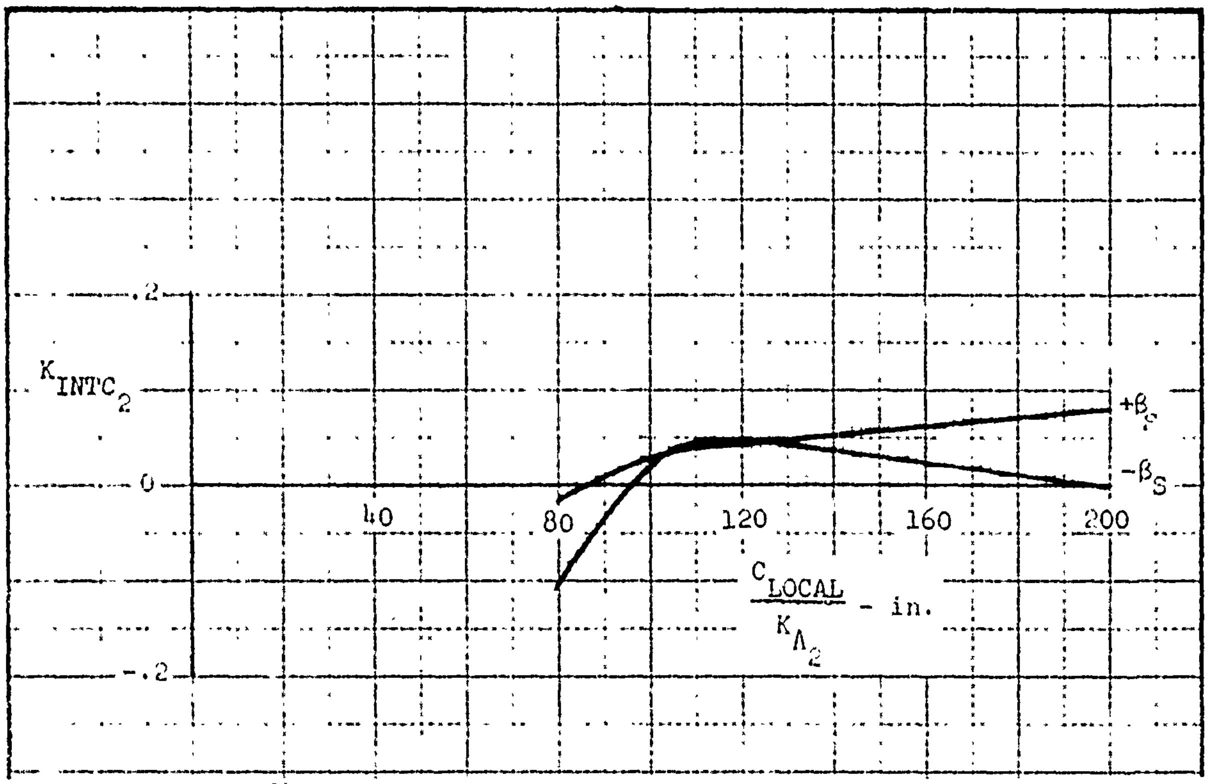

Figure 184. Incremental Normal Force Intercept Due to Yaw - K_{INTC} for Mach Break 2

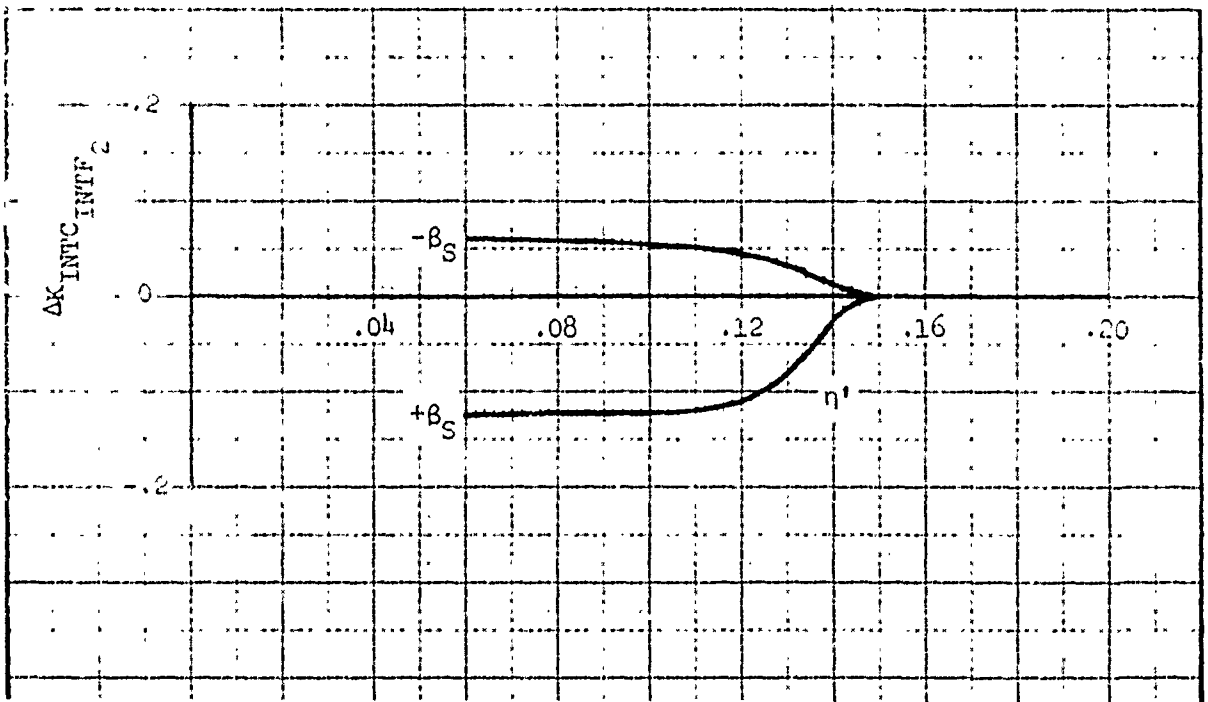

Figure 185. Incremental Normal Force Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

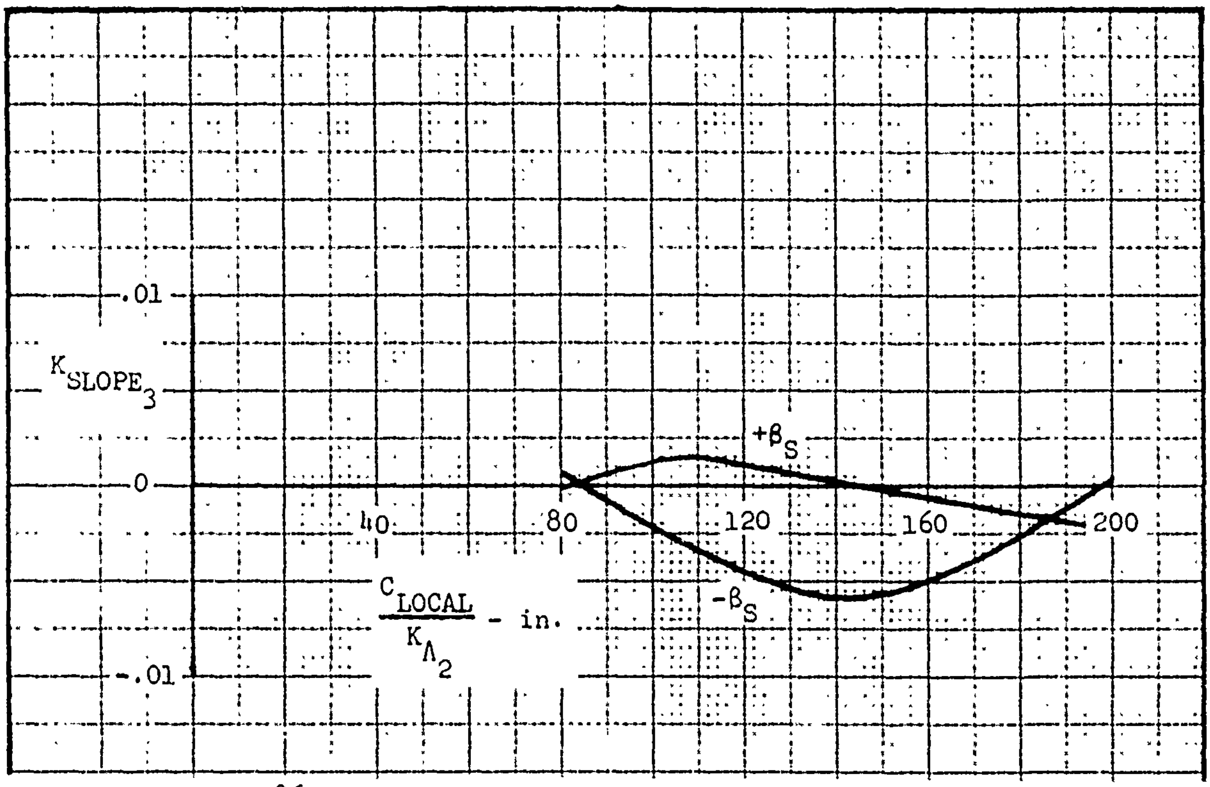

Figure 186. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE} for Mach Break 3

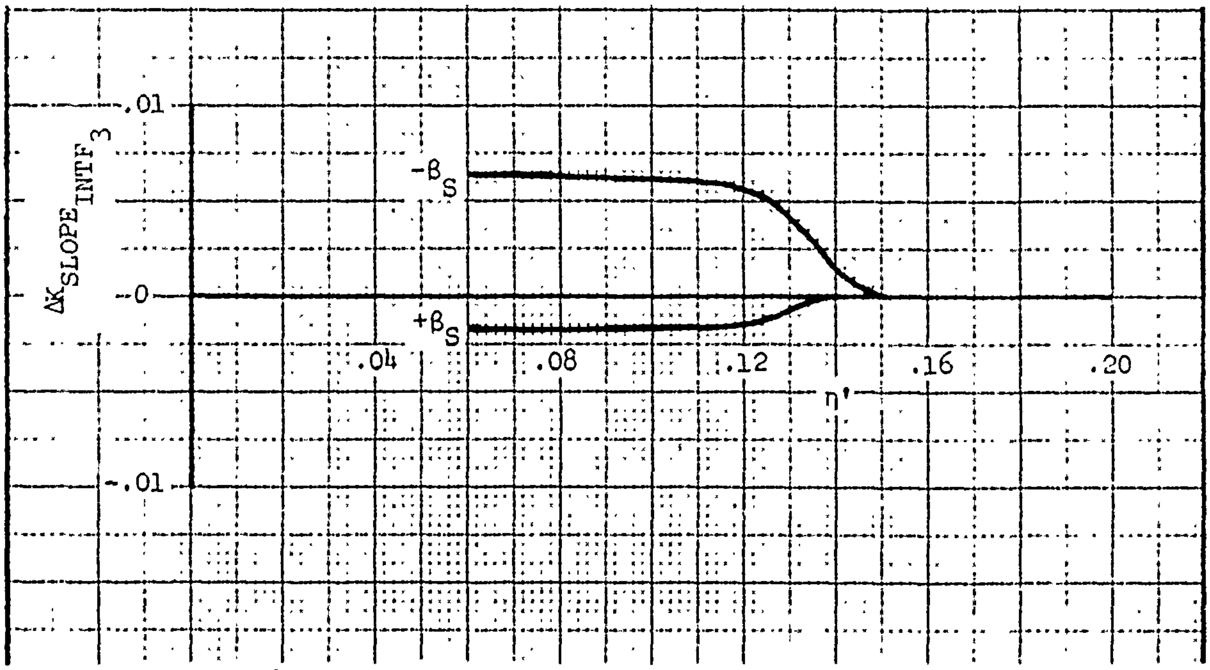

Figure 187. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_3} Fuselage Interference Correction

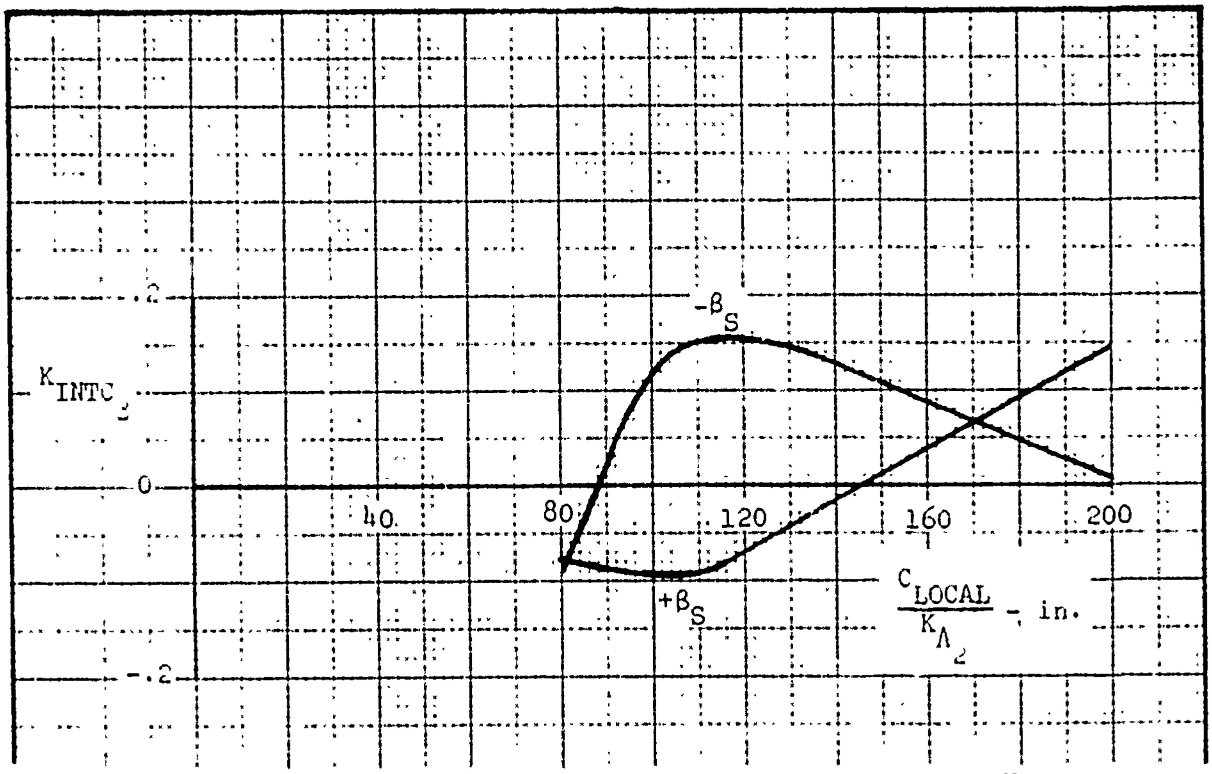

Figure 188. Incremental Normal Force Intercept Due to Yaw - K_{INTC} For Mach Break 3

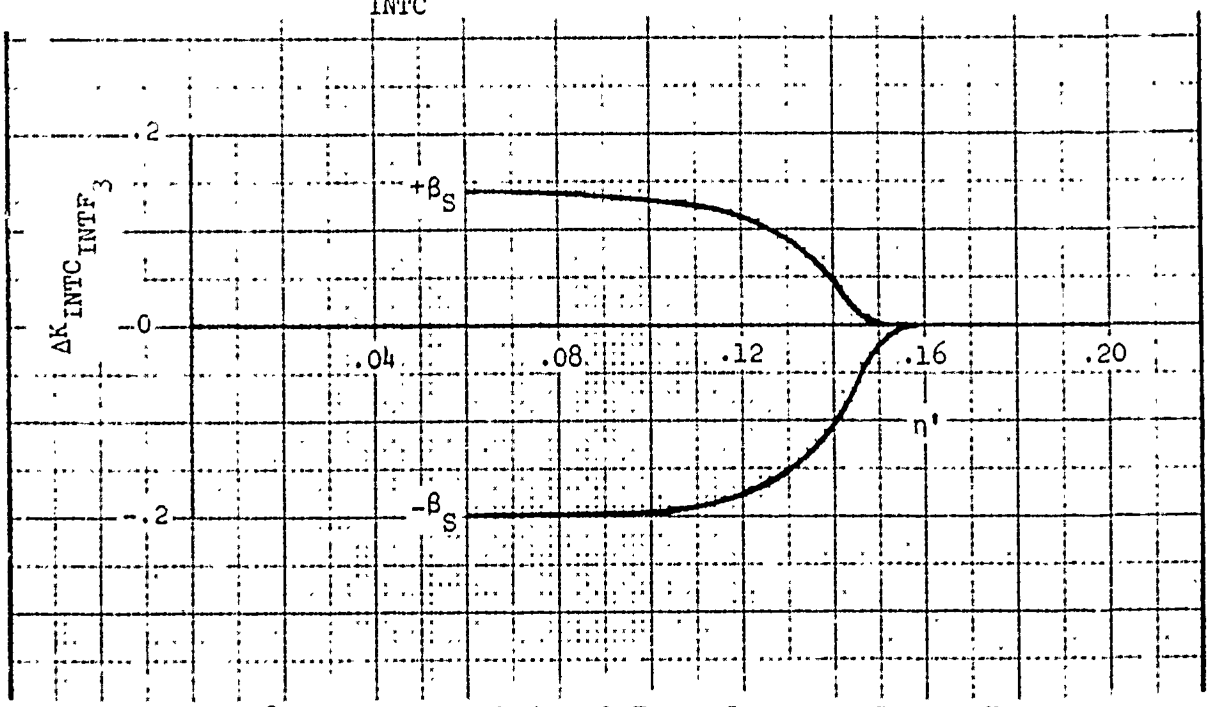

Figure 189. Incremental Normal Force Intercept Due to Yaw - K_{INTC_3} Fuselage Interference Correction

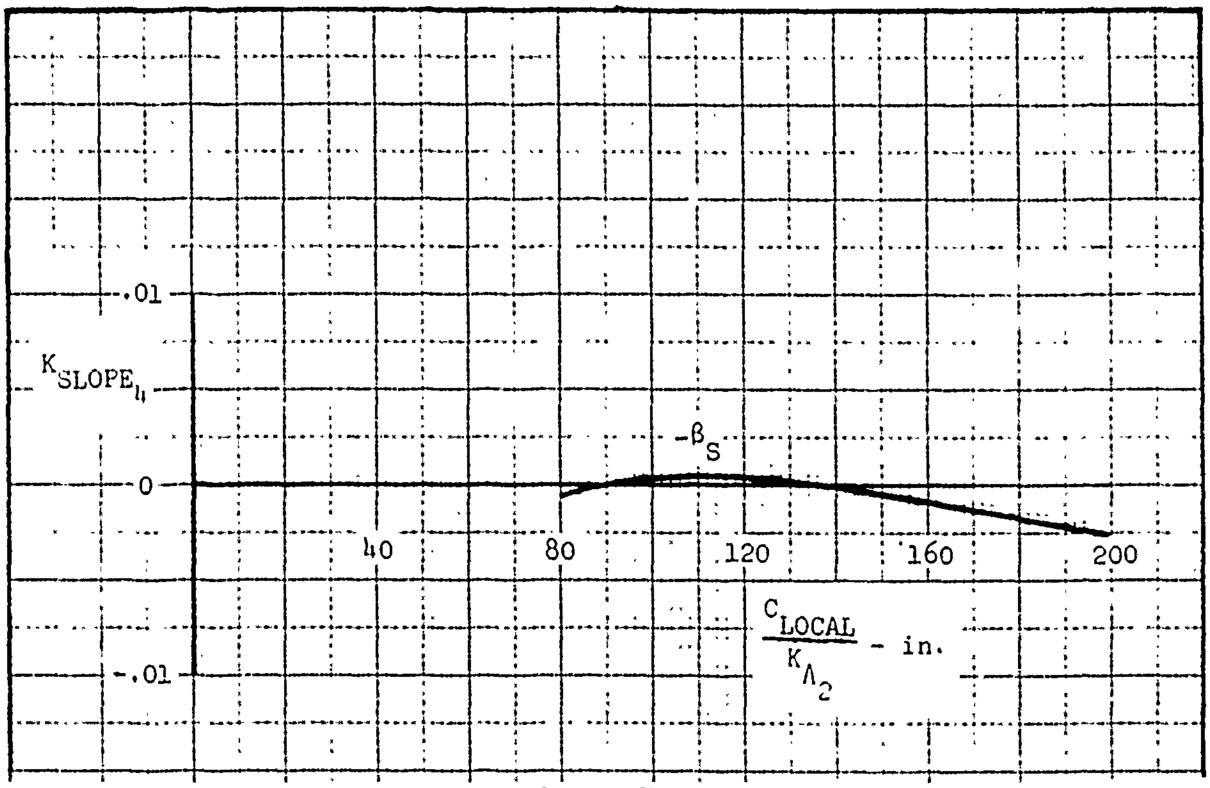

Figure 190. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE} for Mach Break 4

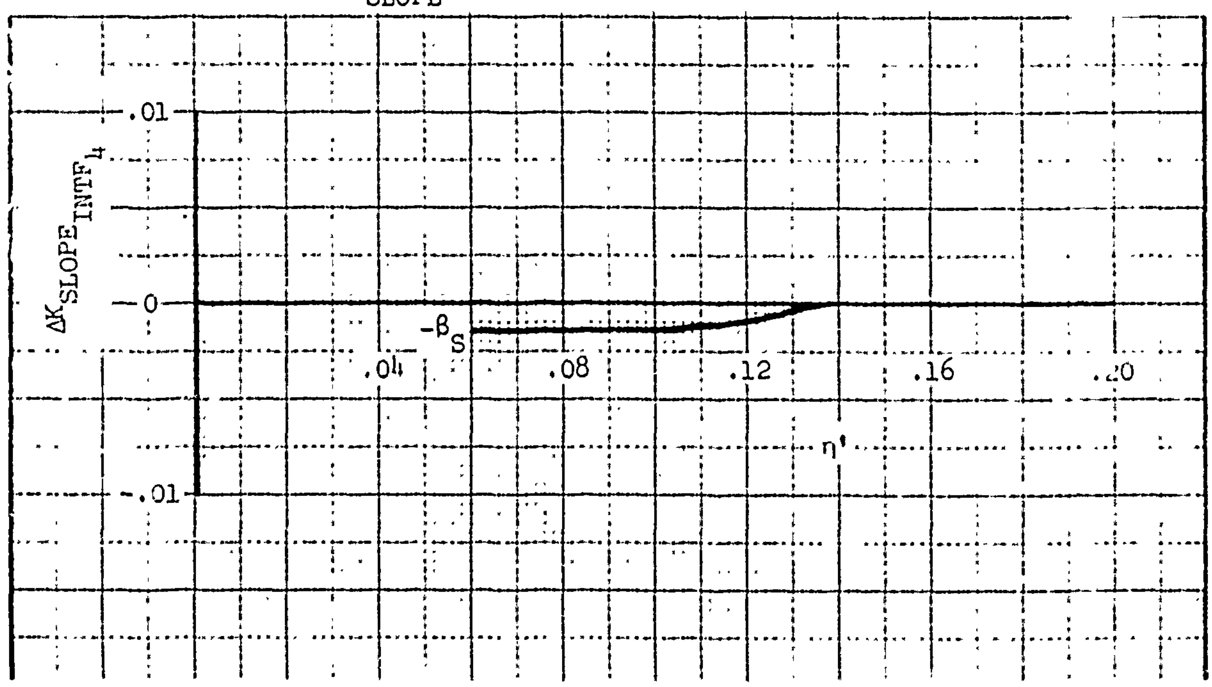

Figure 191. Incremental Normal Force Intercept Due to Yaw - K_{SLOPE_4} Fuselage Interference Correction

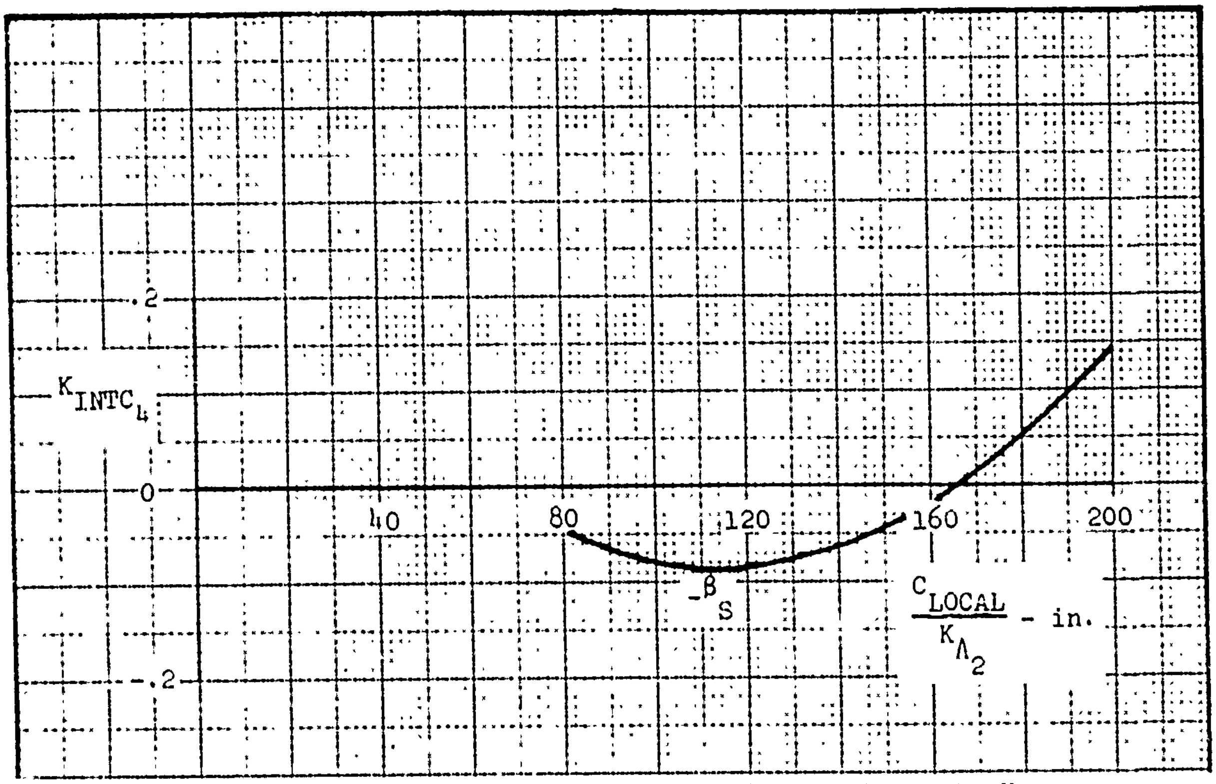

Figure 192. Incremental Normal Force Intercept Due to Yaw - K_{INTC} for Mach Break 4

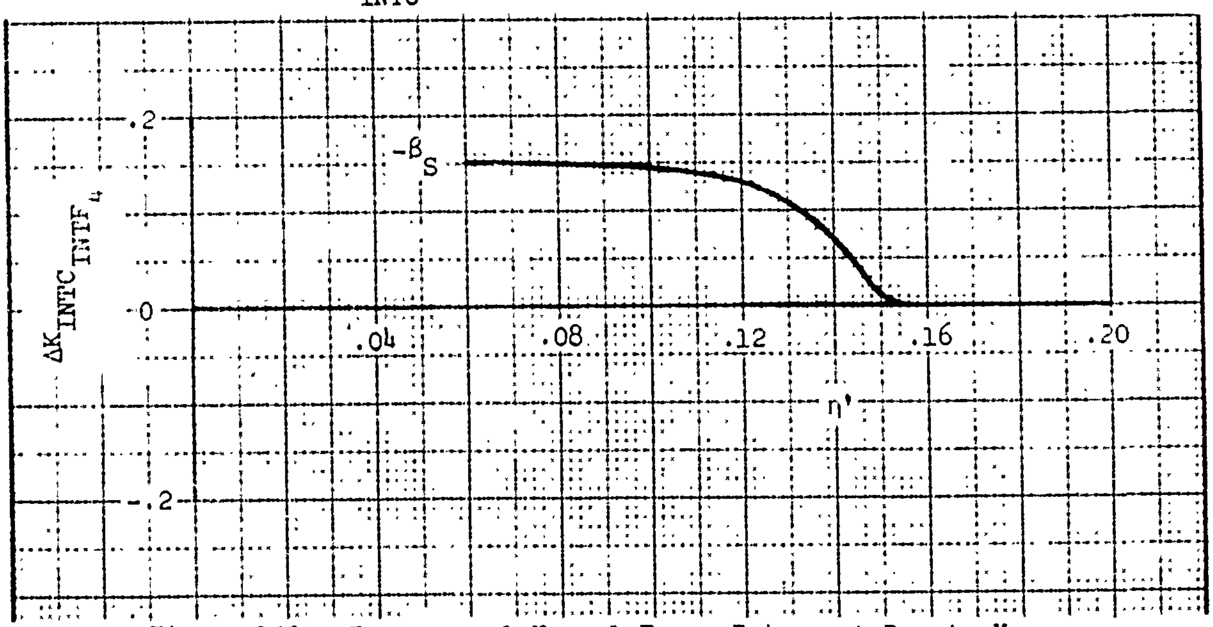

Figure 193. Incremental Normal Force Intercept Due to Yaw - K_{INTC_4} Fuselage Interference Correction

3.3.3 Increment - Adjacent Store Interference

The discussion of normal force slope and intercept increments due to adjacent store interference is similar to that of side force found in Subsection 3.1.3.

3.3.3.1 Slope Prediction

The equation to predict incremental normal force slope, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$, for M = 0.5 is given below.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}=K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF}+200)}{d\cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right)+ K_{INTC_2}$$

and additionally

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 194.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 195.

$\frac{d_{INTF}(x_{INTF}+200)}{d\cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

A numerical example illustrating the use of the above equation is found in Subsection 3.1.3.1.

3.3.3 Increment - Adjacent Store Interference

The discussion of normal force slope and intercept increments due to adjacent store interference is similar to that of side force found in Subsection 3.1.3.

3.3.3.1 Slope Prediction

The equation to predict incremental normal force slope, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$, for M = 0.5 is given below.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right) S_{REF}$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 194.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 195.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

A numerical example illustrating the use of the above equation is found in Subsection 3.1.3.1.

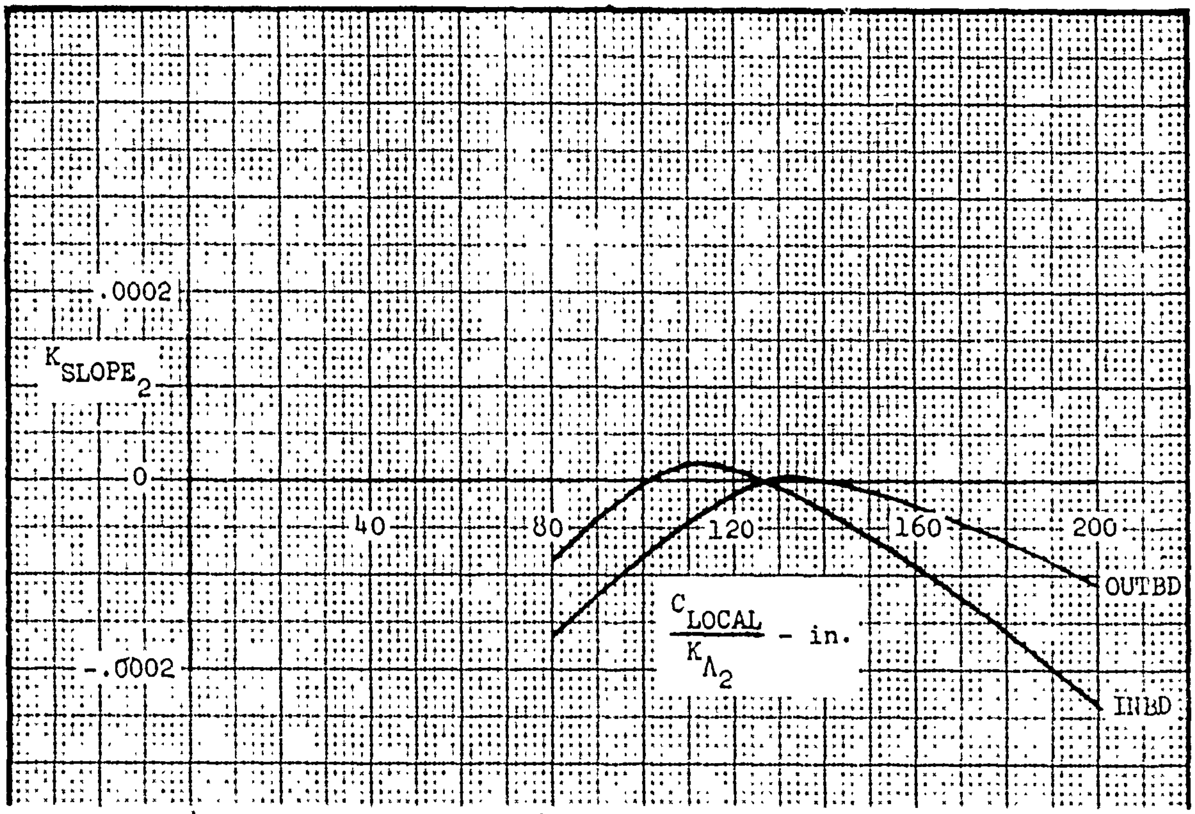

Figure 194. Incremental Normal Force Slope Due to Interference - K_{SLOPE_2} for Inboard and Outboard Interference M=0.5

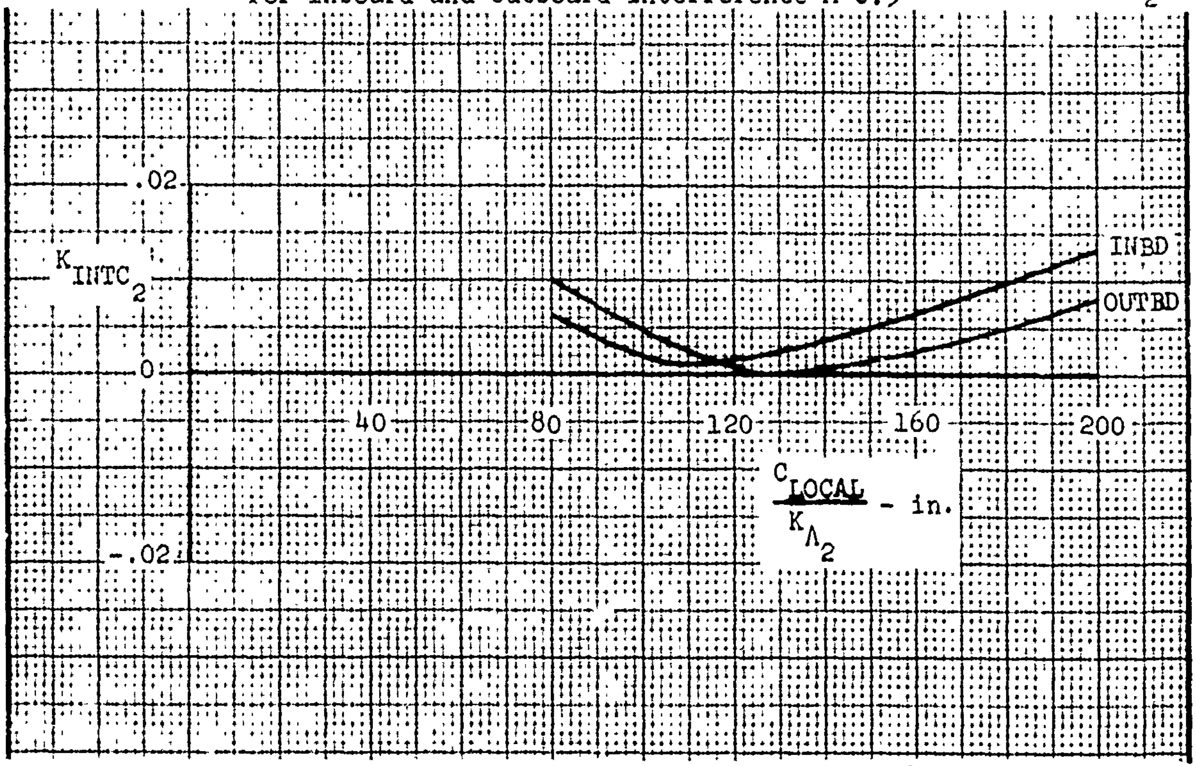

Figure 195. Incremental Normal Force Slope Due to Interference - K_{INTC_2} for Inboard and Outboard Interference M=0.5

3.3.3.2 Slope Mach Number Correction

To compute the variation in incremental normal force slope, $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$, between M = 0.5 and M = 2.0, use the following expression.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=x}}} = \Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=0.5}}} + \Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=x}}}$$

where:

$\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=0.5}}}$ - Incremental normal force slope at M = 0.5.

$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=x}}}$ - Incremental change with Mach number from the incremental normal force slope value at M = 0.5

A generalized curve illustrating the incremental normal force slope variation with Mach number is given by Figure 196.

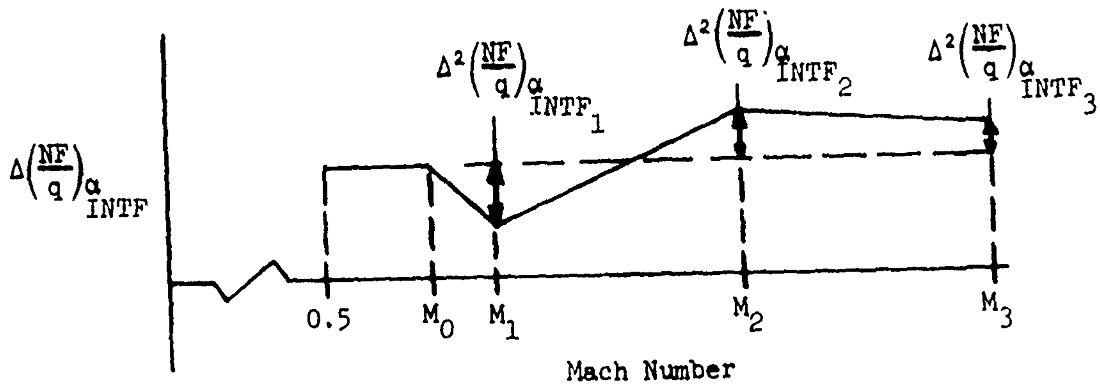

Figure 196. Incremental Normal Force Slope Due to Interference - Generalized Mach Number Variation

The incremental slope variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, and M_3. The variation of the Mach break points is presented in Figure 197

as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is the Mach number where the incremental slope initially deviates from the value predicted at M = 0.5. Equations to predict the incremental changes at the remaining Mach break points are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_1}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.\ PPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg}$; Figure 198.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 199.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Break 2 (M_2):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_2}} = K_{SLOPE_3}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_3} = K_{SLOPE_4}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4}$$

and additionally,

K_{SLOPE_4} - Variation of K_{SLOPE_3} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 200.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_4} - Value of K_{SLOPE_3} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 201.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Break 3 (M_3):

$$\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_3}} = K_{SLOPE_5}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_5} = K_{SLOPE_6}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_6}$$

and additionally,

K_{SLOPE_6} - Variation of K_{SLOPE_5} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$ Figure 202.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_6} - Value of K_{SLOPE_5} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 203.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

To compute $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$ at M = x, first determine from Figure 197 between which Mach number break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Then compute $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$ at M = x from the following equation.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=x}}} = \Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M=0.5}}} + \Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M_{LOW}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right) \left[\Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M_{HI}}}} - \Delta^2\left(\frac{NF}{q}\right)_{\alpha_{INTF_{M_{LOW}}}}\right]$$

If $x > 1.6$, then $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$ at M = x equals the value given at M = 1.6.

If $x \leq M_0$, then $\Delta\left(\frac{NF}{q}\right)_{\alpha_{INTF}}$ at M = x equals the value obtained in Section 3.3.3.1 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 3.2.2.2.

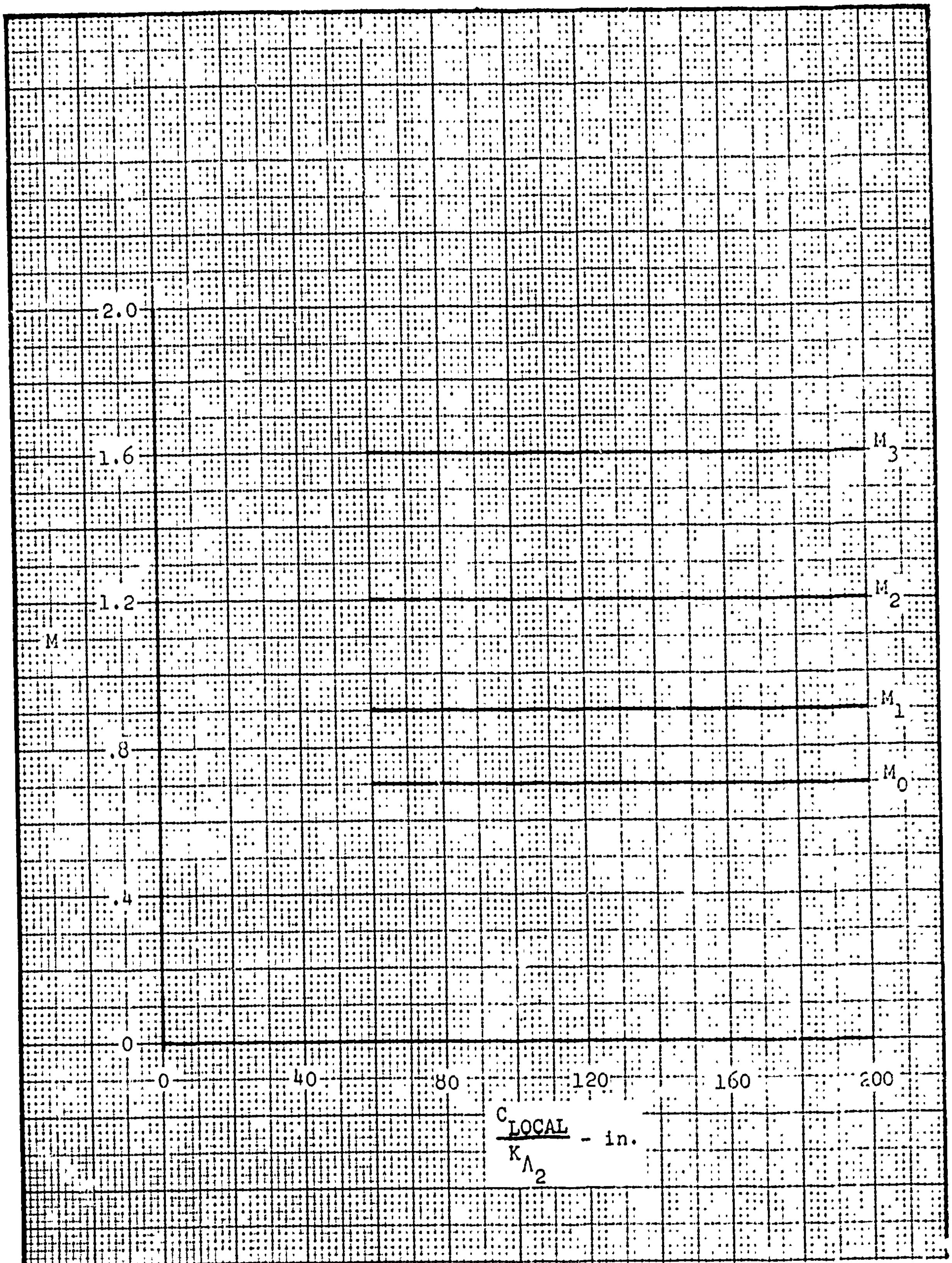

Figure 197. Incremental Normal Force Slope Due to Interference - Mach Number Break Points for Inboard and Outboard Interference

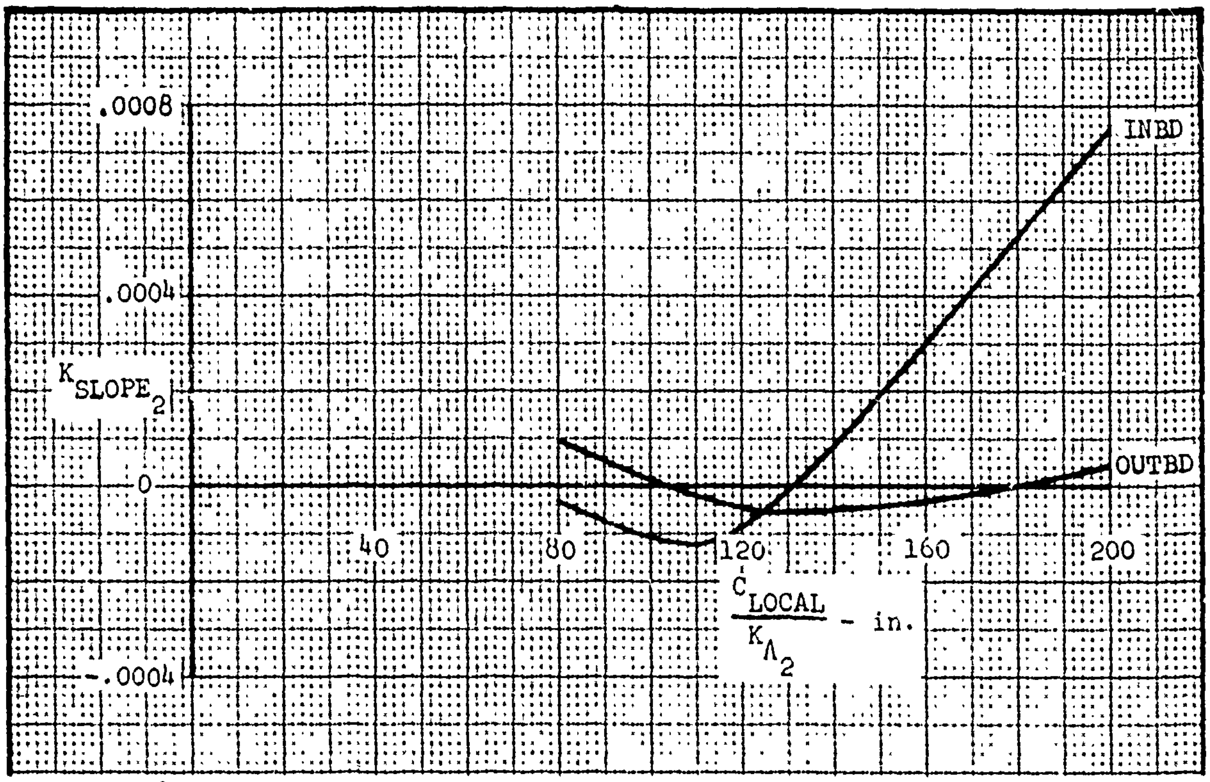

Figure 198. Incremental Normal Force Slope Due to Interference - K_{SLOPE_2} for Inboard and Outboard Adjacent Store Interference

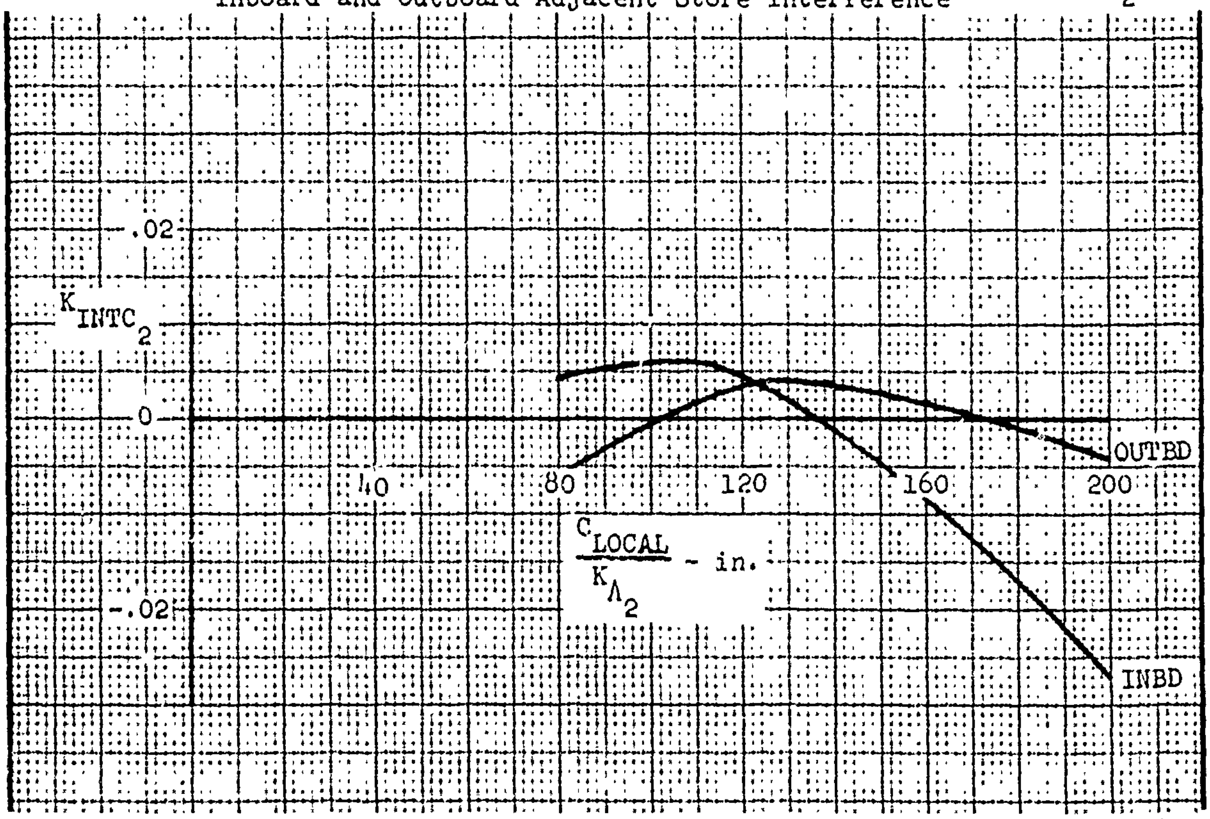

Figure 199. Incremental Normal Force Slope Due to Interference - K_{INTC_2} for Inboard and Outboard Adjacent Store Interference

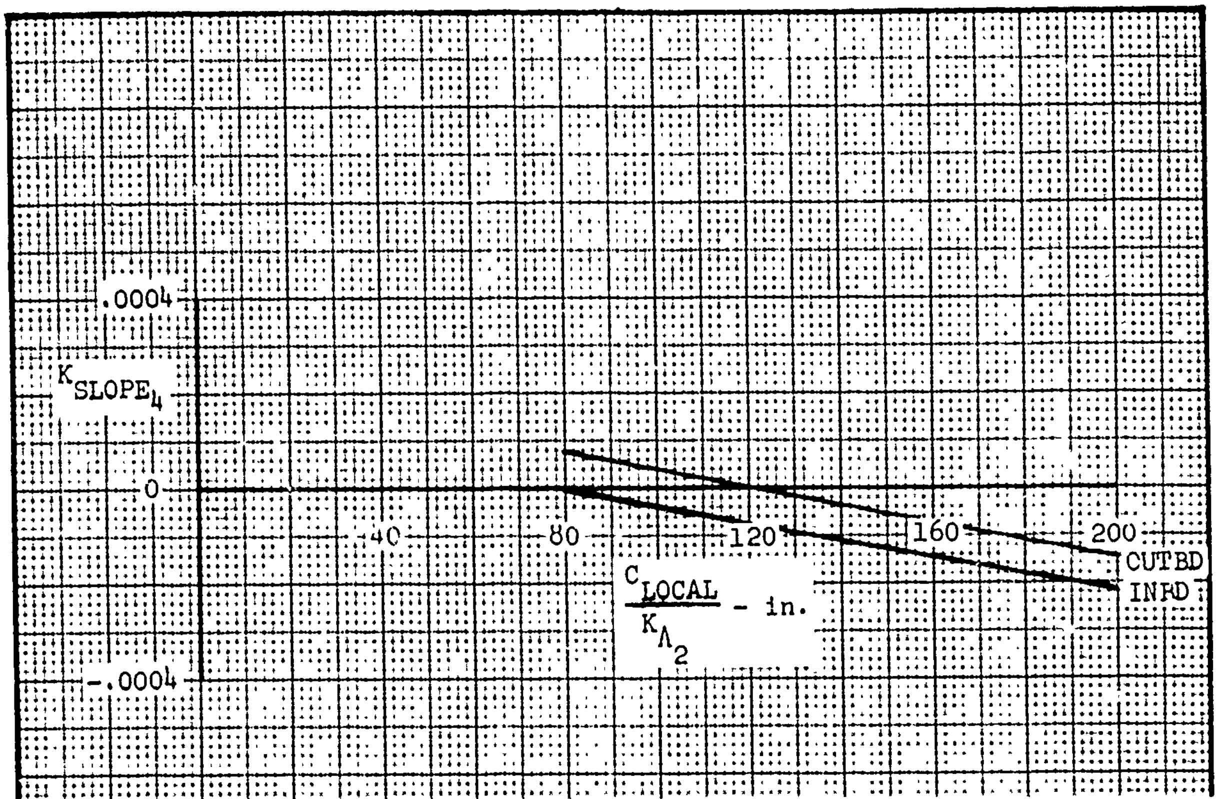

Figure 200. Incremental Normal Force Slope Due to Interference - K_{SLOPE_4} for Inboard and Outboard Adjacent Store Interference

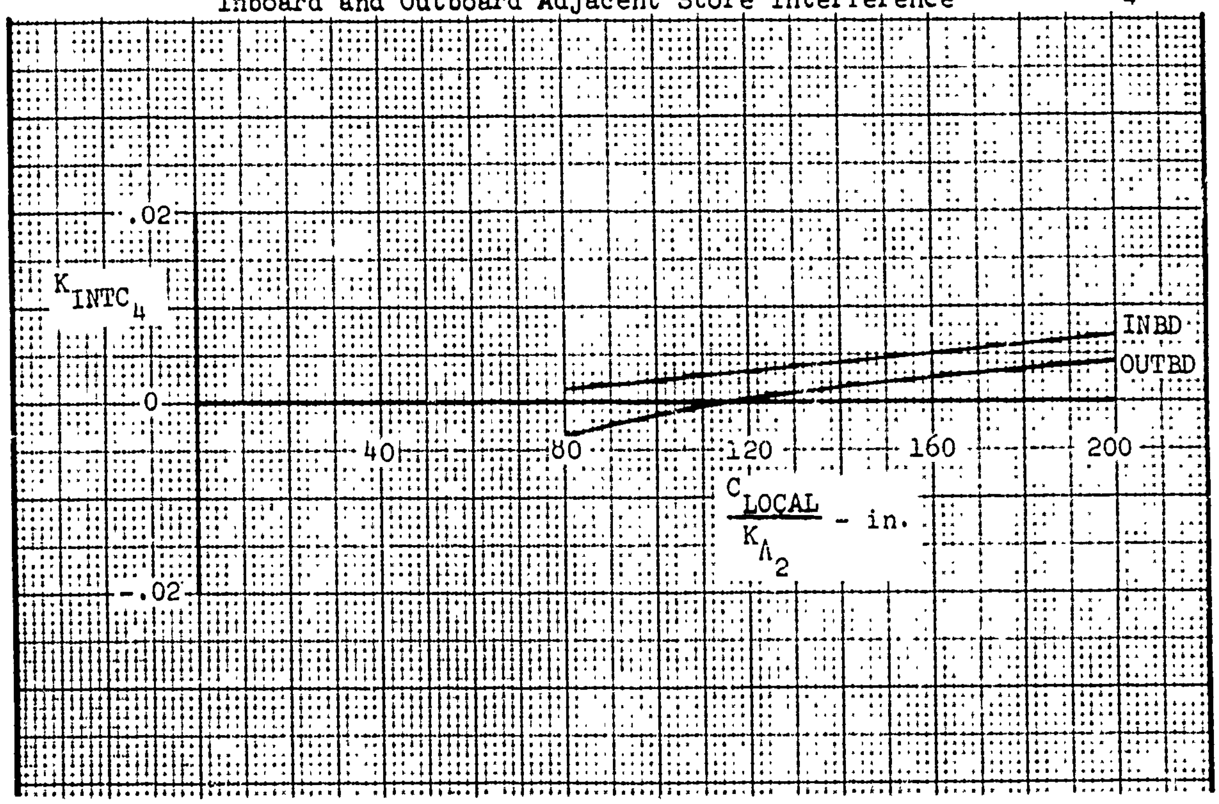

Figure 201. Incremental Normal Force Slope Due to Interference - K_{INTC_4} for Inboard and Outboard Adjacent Store Interference

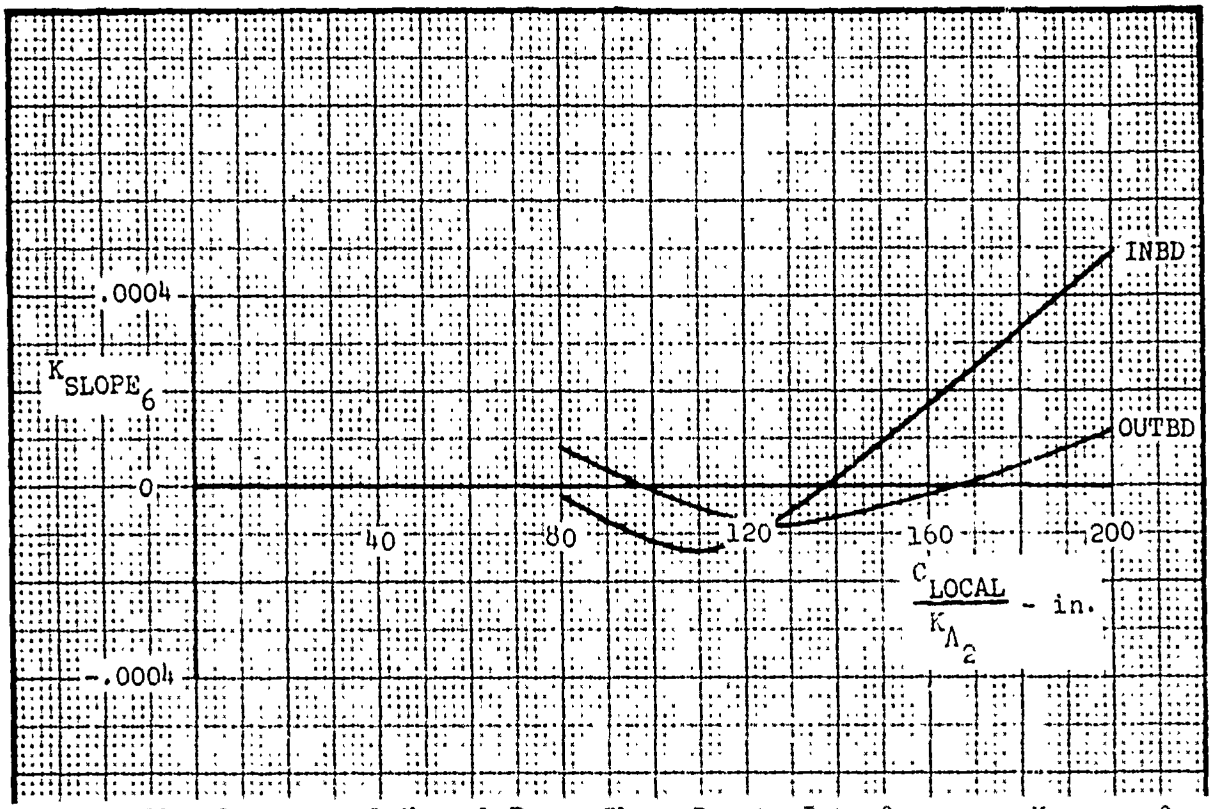

Figure 202. Incremental Normal Force Slope Due to Interference - K_{SLOPE_6} for Inboard and Outboard Adjacent Store Interference

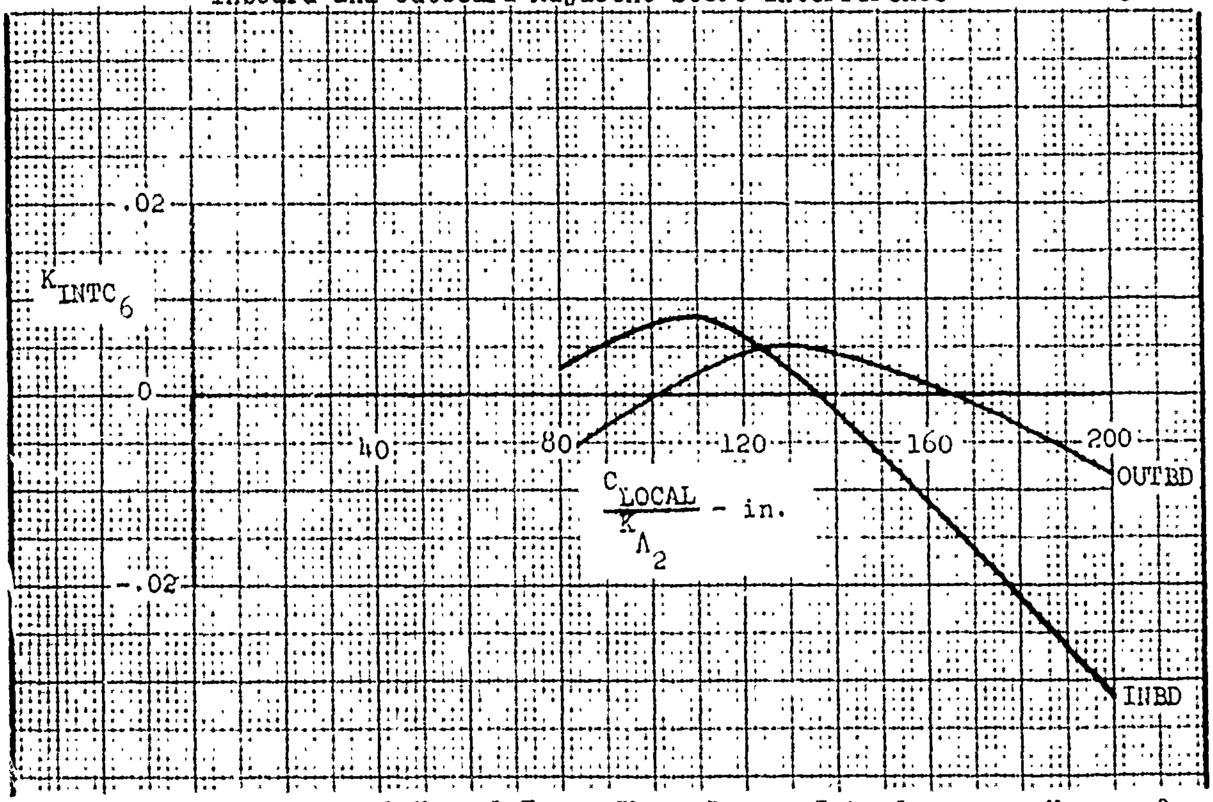

Figure 203. Incremental Normal Force Slope Due to Interference - K_{INTC_6} for Inboard and Outboard Adjacent Store Interference

3.3.3.3 Intercept Prediction

The equation to predict incremental normal force intercept, $\Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ INTF}}$, for M = 0.5 is given below.

$$\Delta\left(\frac{NF}{q}\right)_{\substack{\alpha=0 \\ INTF}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.\ PPA}{L}$, $\frac{1}{in.}$, Figure 204.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, Figure 205.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

A numerical example illustrating the use of the above equation is found in Subsection 3.1.3.1.

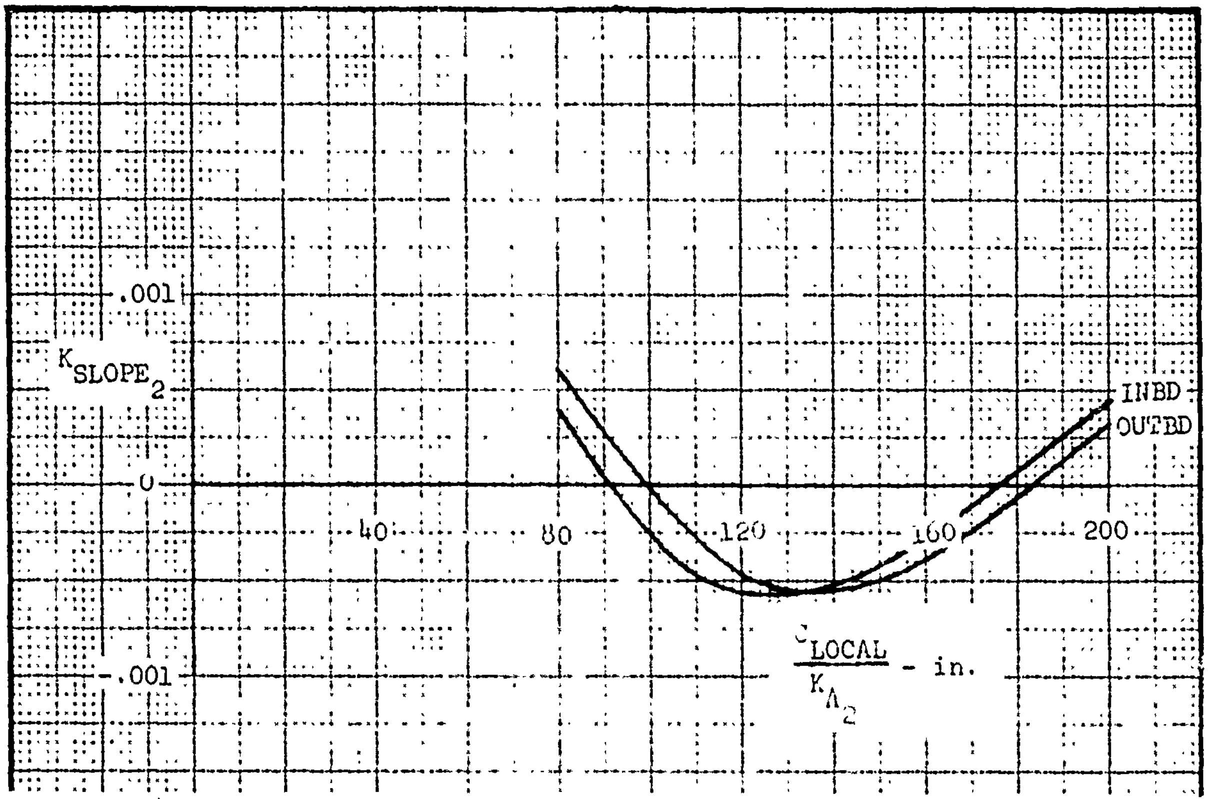

Figure 204. Incremental Normal Force Intercept Due to Interference - K_{SLOPE_2} for Inboard and Outboard Adjacent Store Interference M=0.5

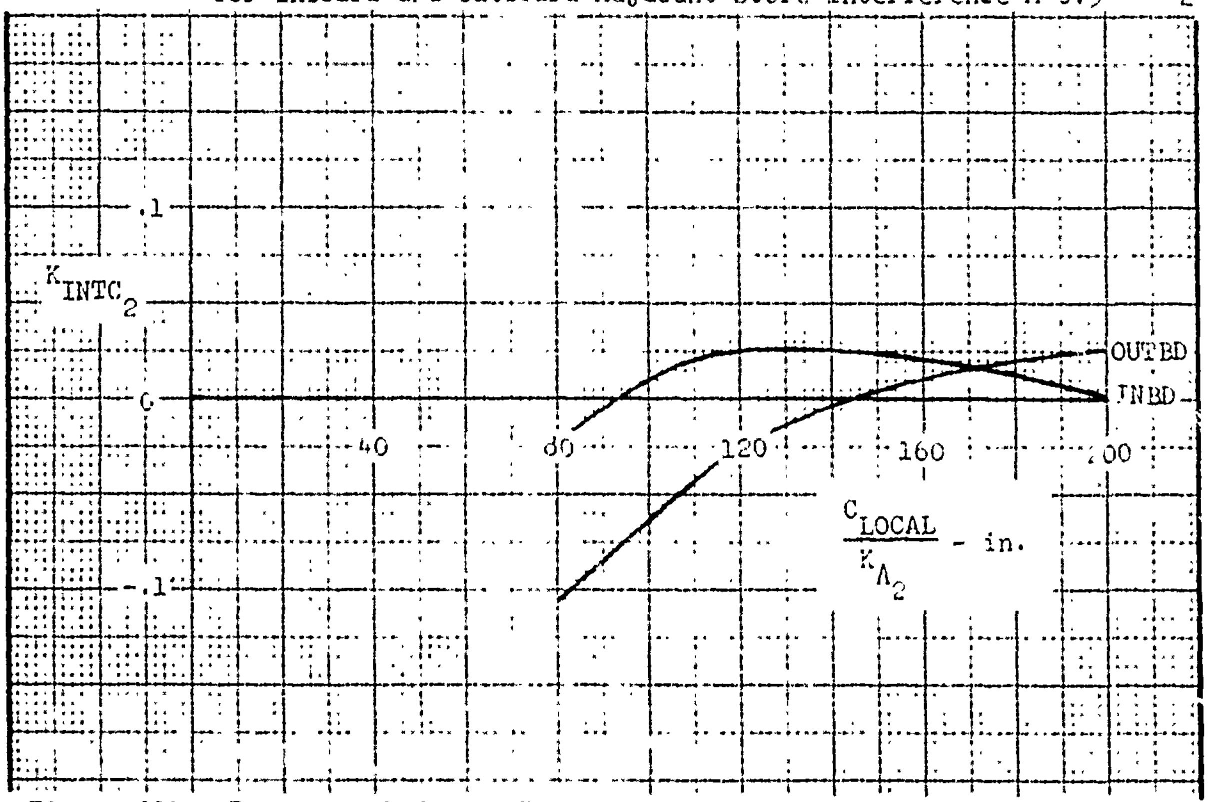

Figure 205. Incremental Normal Force Intercept Due to Interference - K_{INTC_2} for Inboard and Outboard Adjacent Store Interference M=0.5

3.3.3.4 Intercept Mach Number Correction

The procedure to compute the incremental normal force intercept between M = 0.5 and M = 2.0 is similar to that of incremental slope as found in Subsection 3.3.3.2.

A generalized curve depicting the incremental normal force intercept variation with Mach number is given by Figure 206.

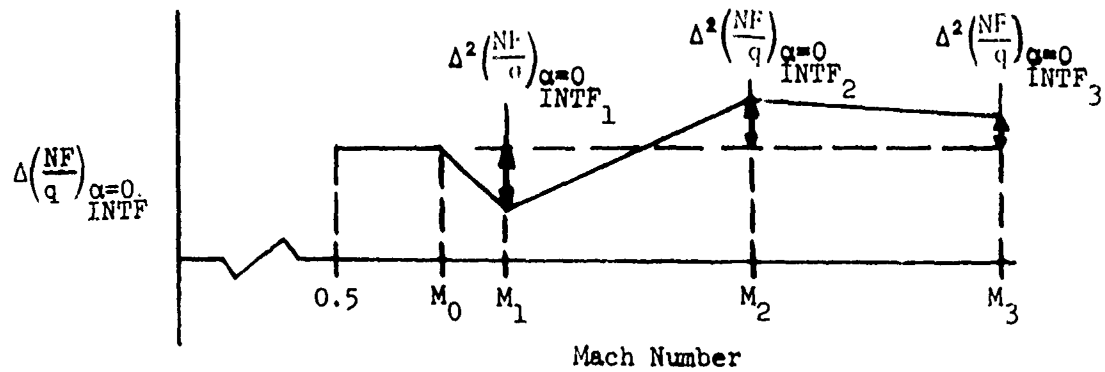

Figure 206. Incremental Normal Force Intercept Due to Interference - Generalized Mach Number Variation

The incremental intercept variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, and M_3. The variation of the Mach break points is presented in Figure 207 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is the Mach number where the incremental intercept initially deviates from the value predicted at M = 0.5. Equations to predict the incremental changes at the remaining Mach break points are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\INTF_1}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 208.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, Figure 209.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Break 2 (M_2):

$$\Delta^2\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\INTF_2}} = K_{SLOPE_3}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}$$

where:

$$K_{SLOPE_3} = K_{SLOPE_4}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4}$$

and additionally,

K_{SLOPE_4} - Variation of K_{SLOPE_3} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 210.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_4} - Value of K_{SLOPE_3} when $\frac{ADJ.PPA}{L} = 0$, Figure 211.

$\frac{d_{INTF}(x_{INTF} + 200)}{x \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$. ft^2.

Break 3 (M_3):

$$\Delta^2\left(\frac{NF}{q}\right)_{\substack{\alpha=0\\ INTF_3}} = K_{SLOPE_5}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right) S_{REF}$$

where:

$$K_{SLOPE_5} = K_{SLOPE_6}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_6}$$

and additionally,

K_{SLOPE_6} - Variation of K_{SLOPE_5} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 212.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_6} - Value of K_{SLOPE_5} when $\frac{ADJ.PPA}{L} = 0$, Figure 213.

$\frac{d_{INTF}(x_{INTF} + 200)}{d\ y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

To compute $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{INTF}}$ at $M = x$, first determine from Figure 207 between which Mach number break points $M = x$ occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Then compute $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{INTF}}$ at $M = x$ from the following equation.

$$\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{INTF_{M=x}}} = \Delta\left(\frac{NF}{q}\right)_{\alpha=0_{INTF_{M=0.5}}} + \Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{INTF_{M_{LOW}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)\left[\Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{INTF_{M_{HI}}}} - \Delta^2\left(\frac{NF}{q}\right)_{\alpha=0_{INTF_{M_{LOW}}}}\right]$$

If $x > 1.6$, then $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{INTF}}$ at $M = x$ equals the value given at $M = 1.6$.

If $x \leq M_0$, then $\Delta\left(\frac{NF}{q}\right)_{\alpha=0_{INTF}}$ at $M = x$ equals the value obtained in Subsection 3.3.3.1 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 3.2.2.2.

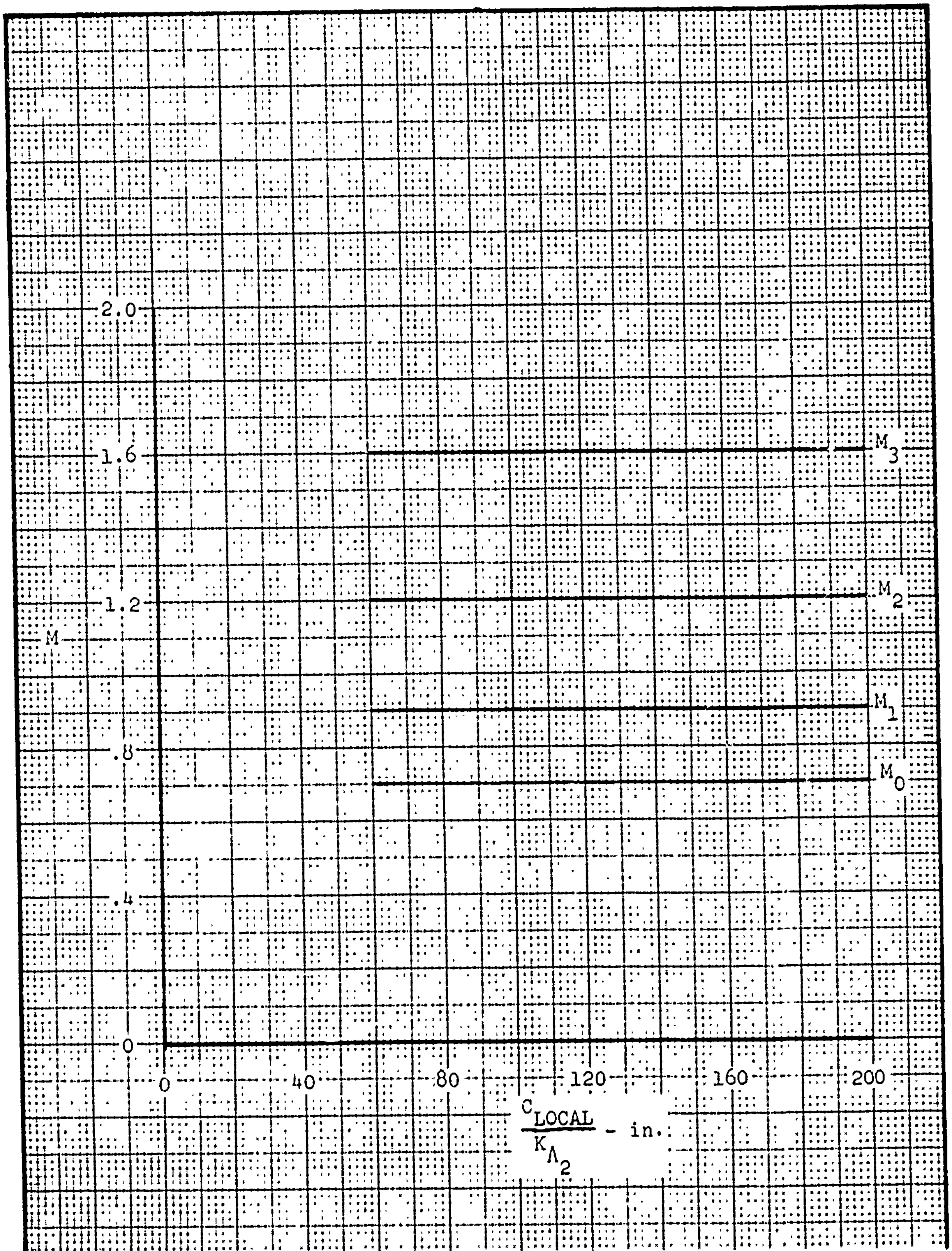

Figure 207. Incremental Normal Force Intercept Due to Interference - Mach Number Break Points for Inboard and Outboard Interference

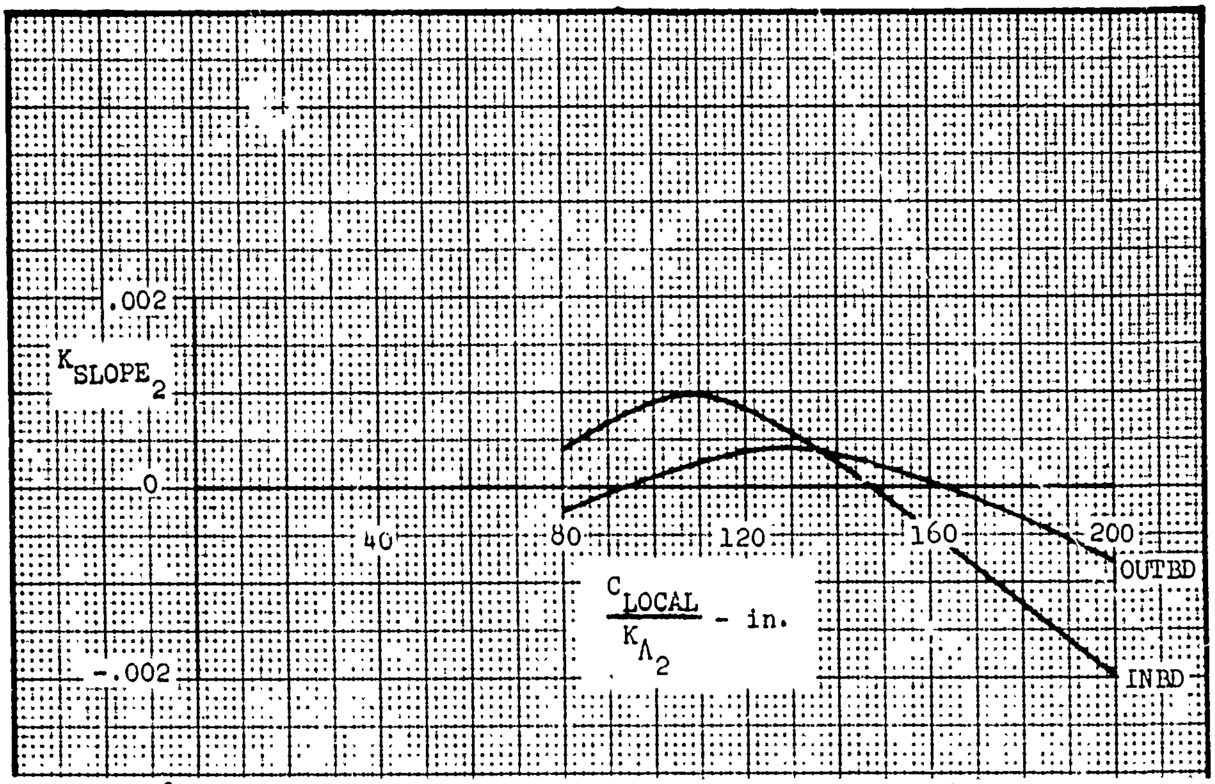

Figure 208. Incremental Normal Force Intercept Due to Interference - K_{SLOPE_2} for Inboard and Outboard Adjacent Store Interference

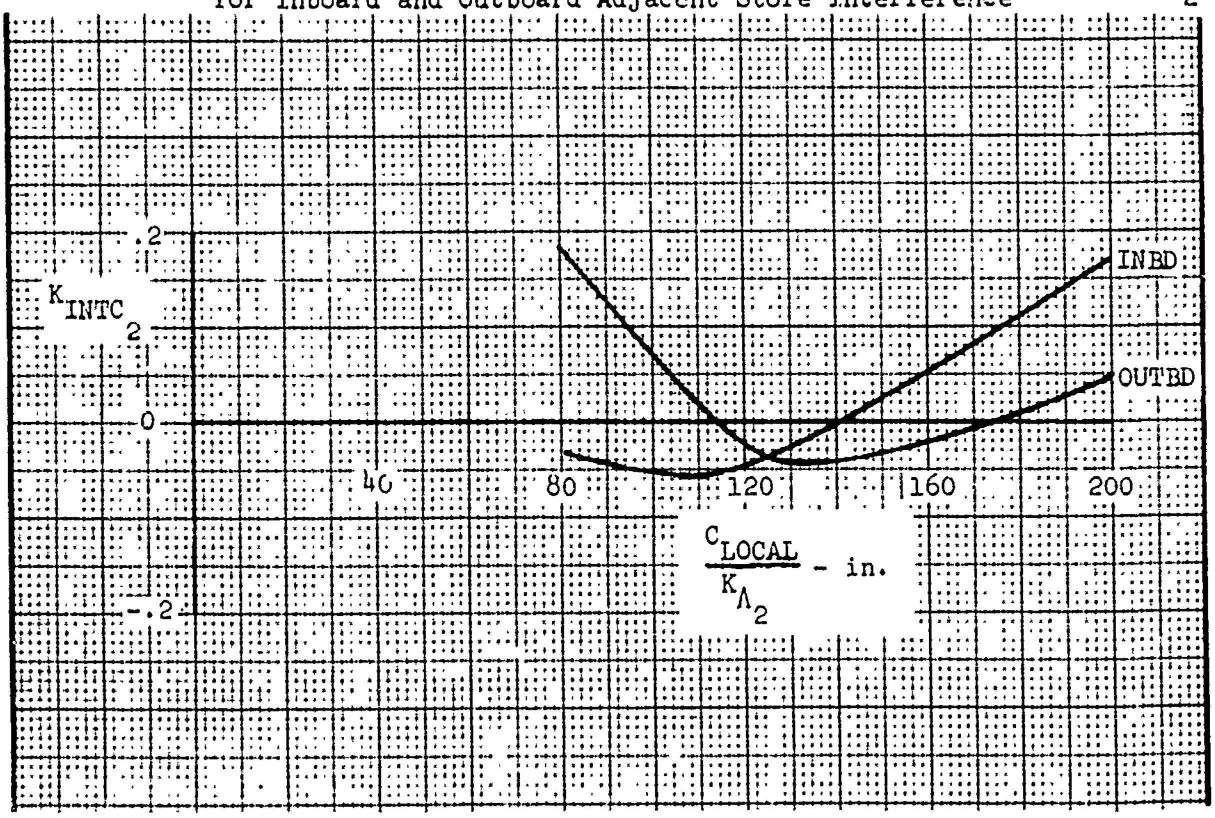

Figure 209. Incremental Normal Force Intercept Due to Interference - K_{INTC_2} for Inboard and Outboard Adjacent Store Interference

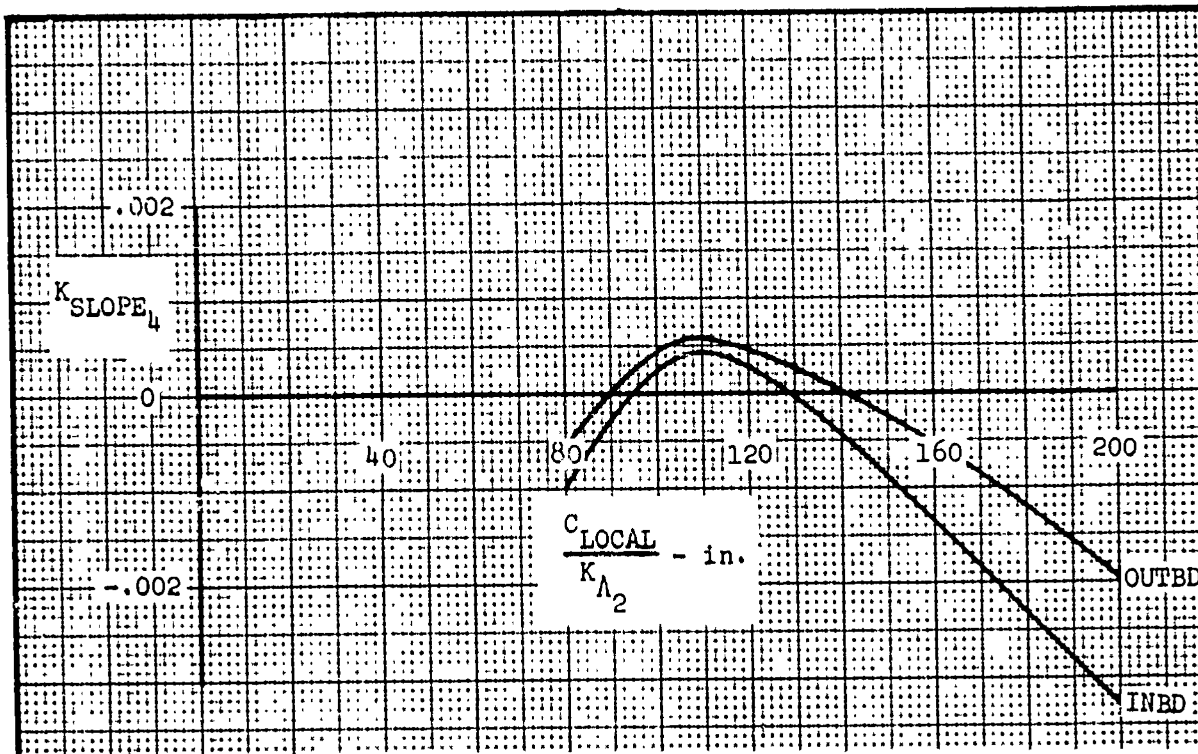

Figure 210. Incremental Normal Force Intercept Due to Interference - K_{SLOPE_4} for Inboard and Outboard Adjacent Store Interference

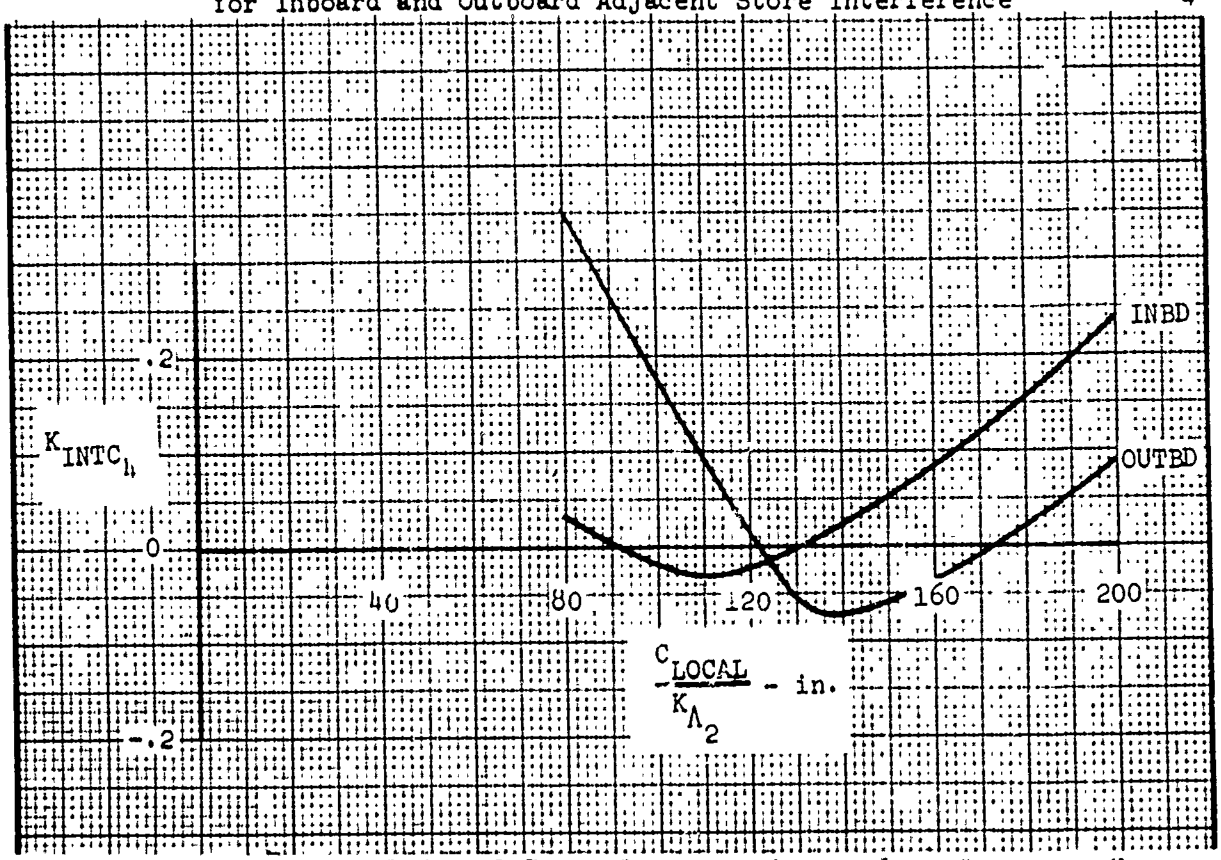

Figure 211. Incremental Normal Force Intercept Due to Interference - K_{INTC_4} for Inboard and Outboard Adjacent Store Interference

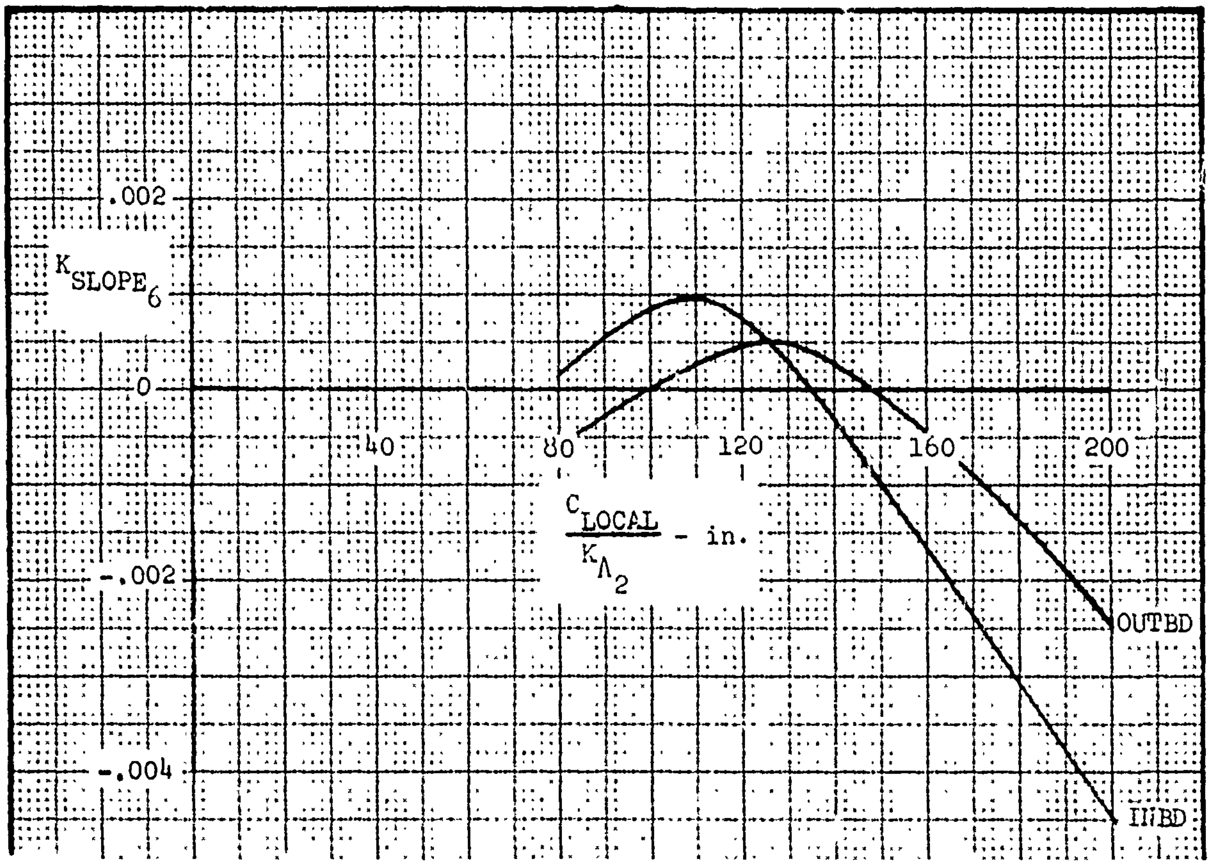

Figure 212. Incremental Normal Force Intercept Due to Interference - K_{SLOPE_6} for Inboard and Outboard Adjacent Store Interference

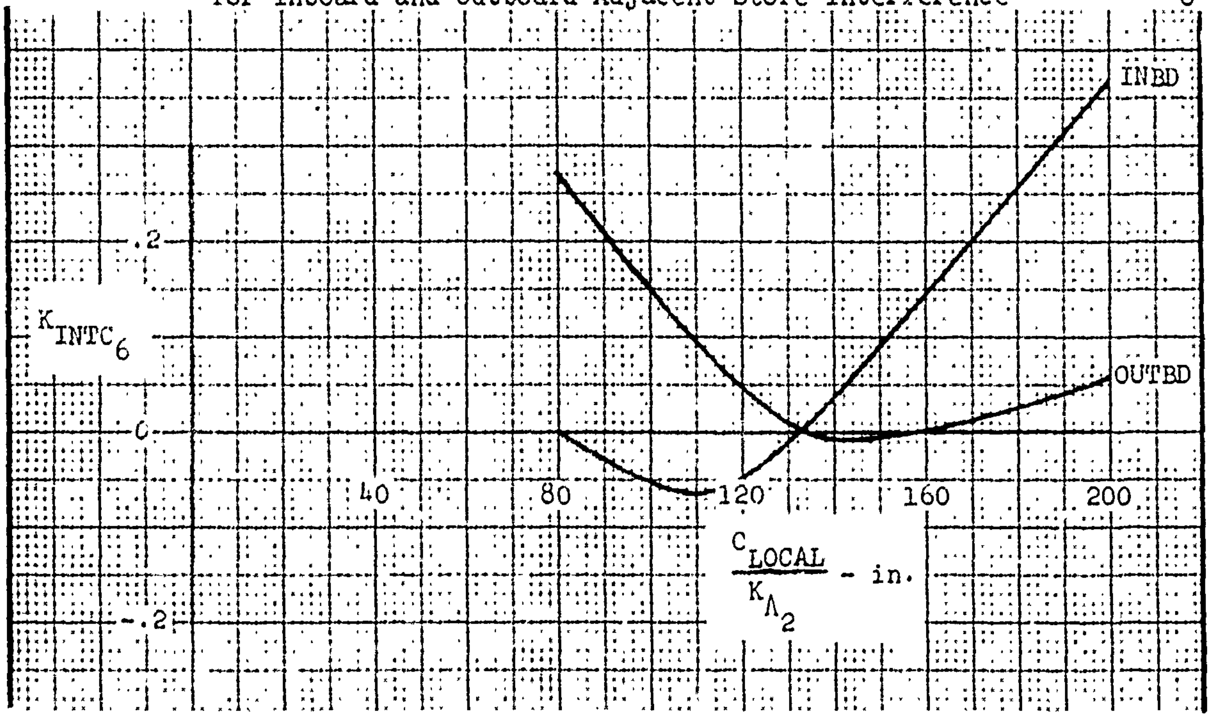

Figure 213. Incremental Normal Force Intercept Due to Interference - K_{INTC_6} for Inboard and Outboard Adjacent Store Interference

3.4 PITCHING MOMENT

3.4.1 Basic Airload

The installed store pitching moment is also influenced by the buoyancy effect discussed in Subsection 3.3.1 and Reference 5. The pitching moment data are referenced along the store centerline at the mid-lug location.

3.4.1.1 Slope Prediction

The variation of captive store pitching moment with angle of attack is defined by the following relationship.

$$\left(\frac{PM}{q}\right)_{\alpha_{PRED}} = K_{\Lambda_2} K_{C_{PM}} \left(\frac{NF}{q}\right)_{\alpha_{ISO}} + \left(\frac{PM}{q}\right)_{\alpha_{BUOY}}$$

where:

$$\left(\frac{PM}{q}\right)_{\alpha_{BUOY}} = S_{REF}\, K_{INTF}\left(K_{INTC_1} + K_{SLOPE_1}\left(\frac{C_{LOCAL}}{K_{\Lambda_2}}\right)\right)$$

The parameters in the above equations are defined below.

$K_{\Lambda_2} = \dfrac{\cos\ \Lambda}{\cos\ 45°}$ - Aircraft wing sweep correction factor where Λ is the sweep angle of the quarter-chord.

$K_{C_{PM}}\left(\frac{NF}{q}\right)_{\alpha_{ISO}}$ - Initial pitching moment slope prediction, $\frac{ft.^3}{deg.}$, see Subsection 2.3.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, $ft.^2$.

K_{INTF} - Interference correction factor based on the ratio of the distance from the fuselage to the store centerline and store diameter, $\frac{y}{d}$, for high wing aircraft, Figure 215.

K_{INTC_1} - $\left(\frac{PM}{qS_{REF}}\right)_{\alpha_{BUOY}}$ at $\left(\frac{C_{LOCAL}}{K_{\Lambda_2}}\right) = 0, \frac{in.}{deg.}$, Figure 214.

K_{SLOPE_1} - Change in $\left(\frac{PM}{qS_{REF}}\right)_{\alpha_{BUOY}}$ with respect to

$$\frac{C_{LOCAL}}{K_{\Lambda_2}}, \frac{\partial\left(\frac{PM}{qS_{REF}}\right)_{\alpha_{BUOY}}}{\partial\left(\frac{C_{LOCAL}}{K_{\Lambda_2}}\right)} = .00260 \frac{1}{deg}$$

Example: Compute $\left(\frac{PM}{q}\right)_\alpha$ for a 300-gallon tank on the A-7 center pylon.

Required for Computation:

$\eta = .418$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_2} = \frac{\cos 35^o}{\cos 45^o} = 1.158$

$S_{REF} = 3.83$ ft.^{2}

$\frac{Y}{d} = 2.57$

NOSE PPA = 1630. in.^{2}

PPA = 5007 in.^{2}

$\frac{L_n}{d} = 3.74$

$K_{C_{PM}} \quad \left(\frac{NF}{q}\right)_{\alpha_{ISC}} = 1.333 \frac{ft.^3}{deg.}$ - Section 2.3.3

$K_{INTF} = 1.05$ - Figure 215

$$\frac{\text{NOSE PPA } L_n}{\text{PPA } d} = \left(\frac{1630}{5007}\right)(3.74) = 1.22$$

$$K_{INTC_1} = -.485 \frac{ft}{deg} \qquad \text{- Figure 214}$$

$$K_{SLOPE_1} = .00260 \frac{ft}{in.\text{-}deg.}$$

therefore:

$$\left(\frac{PM}{q}\right)_{\alpha_{BUOY}} = S_{REF}\, K_{INTF} \left(K_{INTC_1} + K_{SLOPE_1}\left(\frac{C_{LOCAL}}{K_{\Lambda_2}}\right)\right)$$

$$\left(\frac{PM}{q}\right)_{\alpha_{BUOY}} = (\ 3.83\ )\ (1.05\ )\left(-.485 + .00260\ (\ 110\ )\right) = -.800 \frac{ft^3}{deg}$$

and:

$$\left(\frac{PM}{q}\right)_{\alpha_{PRED}} = K_{\Lambda_2}\, K_{C_{PM}} \left(\frac{NF}{q}\right)_{\alpha_{ISO}} + \left(\frac{PM}{q}\right)_{\alpha_{BUOY}}$$

$$\left(\frac{PM}{q}\right)_{\alpha_{PRED}} = 1.158\ (1.333) - .800 = .744 \frac{ft^3}{deg}$$

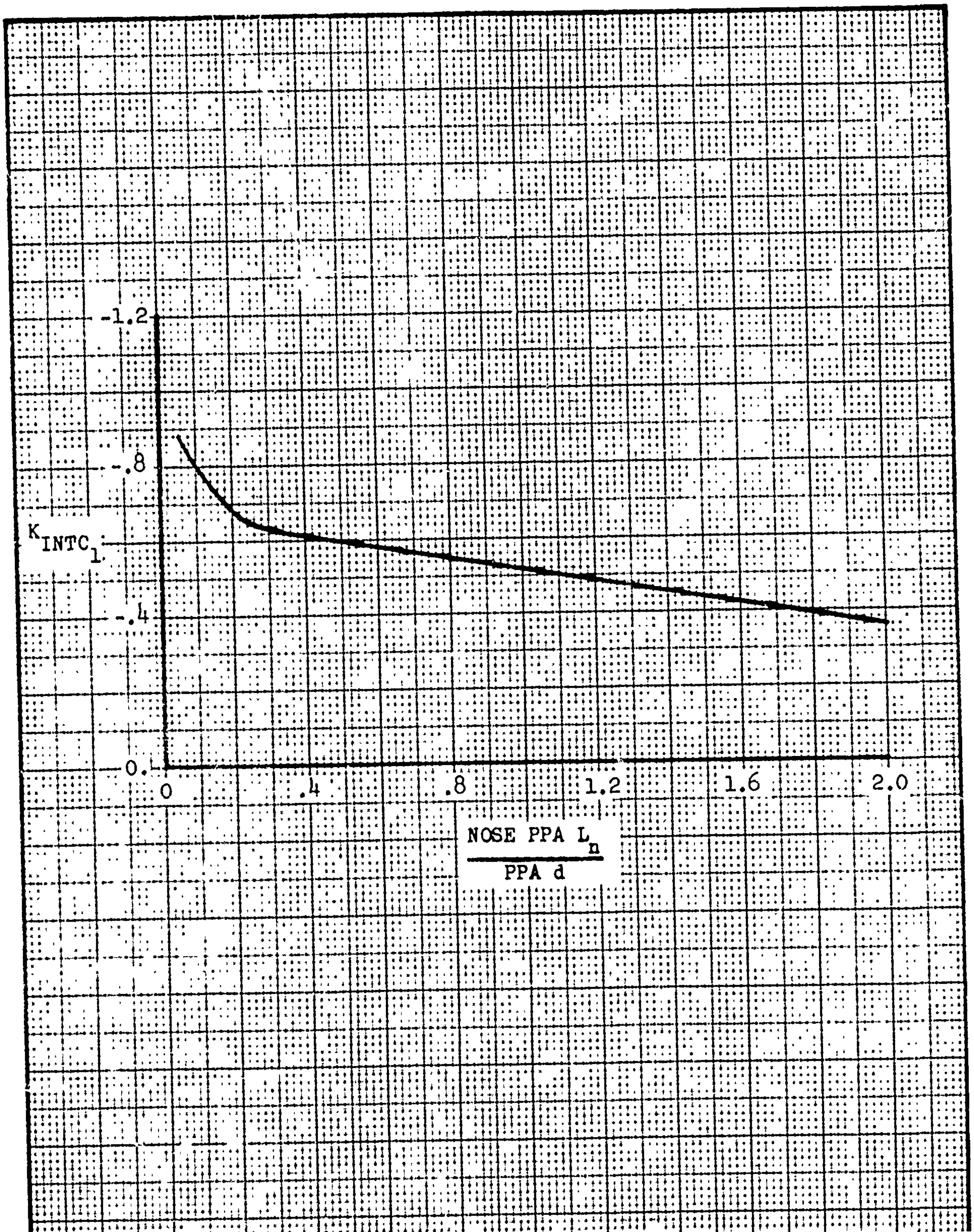

Figure 214 Pitching Moment Slope - K_{INTC_1} for Buoyancy Correction

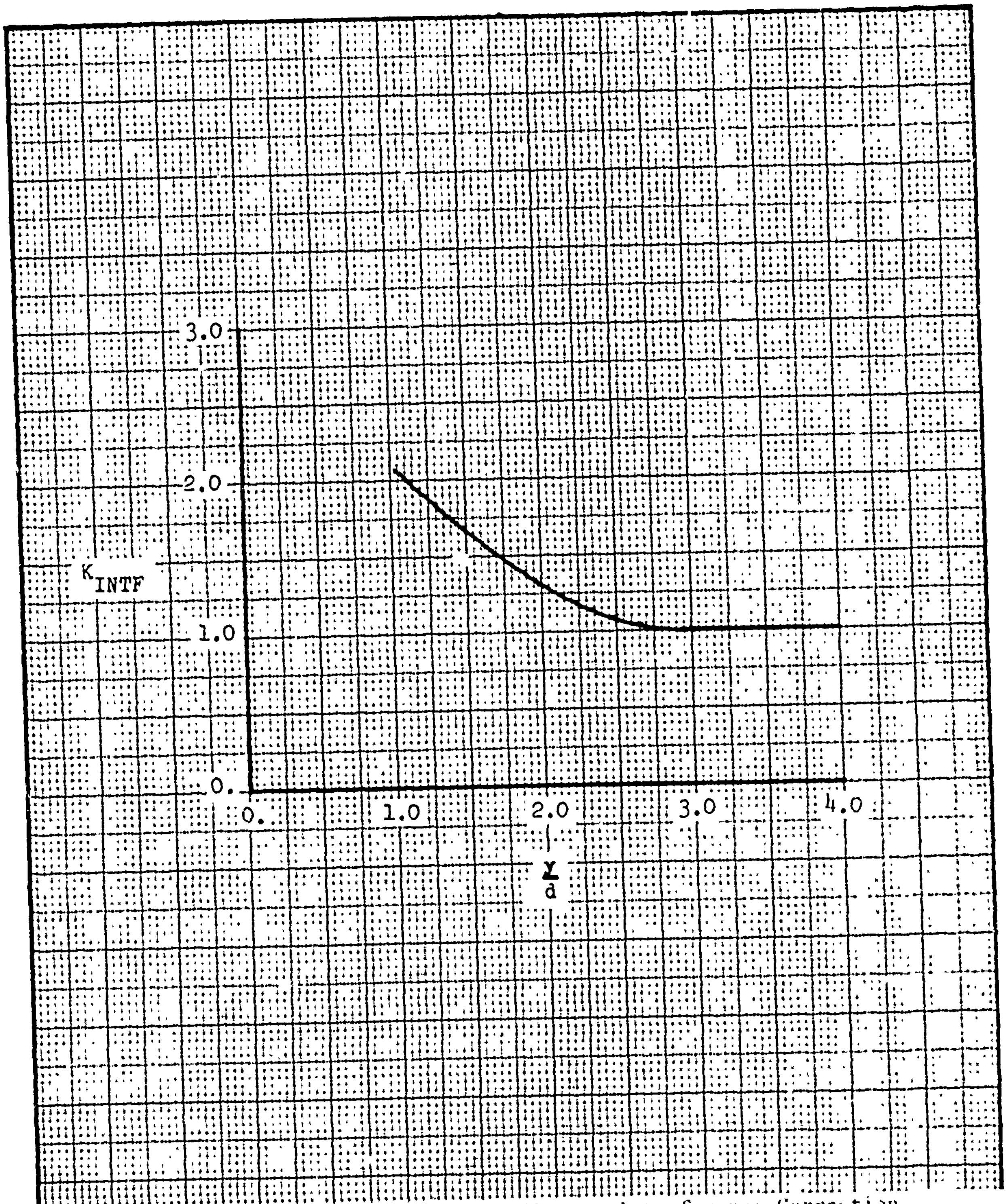

Figure 215. Pitching Moment Slope - Interference Correction

3.4.1.2 Slope Mach Number Correction

To compute the variation in pitching moment slope with angle of attack, $\left(\frac{PM}{q}\right)_\alpha$, between M=0.5 and M=2.0, use the following equation.

$$\left(\frac{PM}{q}\right)_{\alpha_{M=x}} = \left(\frac{PM}{q}\right)_{\alpha_{PRED}} + \Delta\left(\frac{PM}{q}\right)_{\alpha_{M=x}}$$

where:

$\Delta\left(\frac{PM}{q}\right)_{\alpha_{M=x}}$ is the increment in pitching moment slope at M=x.

The generalized curve of the variation of $\left(\frac{PM}{q}\right)_\alpha$ with Mach number is given by Figure 216.

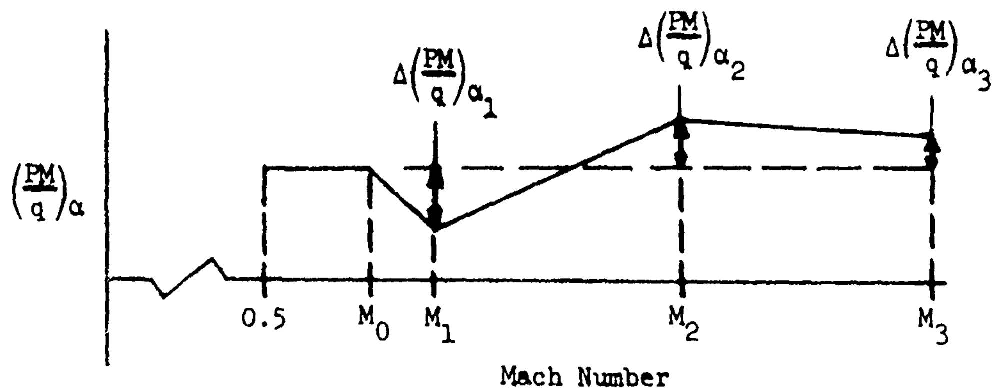

Figure 216. Pitching Moment Slope - Generalized Mach Number Variation

The slope variation with Mach number is approximated by a series of linear segments. Each Mach number where the line segments change slope is designated a break point. The first break point is defined as the Mach number, M_o, where the value of $\left(\frac{PM}{q}\right)_\alpha$ deviates from the subsonic M=0.5 value. The variation of the Mach break points is presented in Figure 217 as a function of C_{LOCAL}. Equations are presented to calculate the incremental slope change at each of the Mach break points. This increment is defined as the difference in pitching moment slope at a Mach break point and the

M=0.5 value of $\left(\frac{PM}{q}\right)_\alpha$. This increment is zero at M_o by the definition of M_o. Equations are presented below to compute the incremental slope changes at M_1, M_2, and M_3.

Break 1 (M_1):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_1} = \left(K_{INTC_1} + \Delta K_{INTC_{L/C}} + K_{SLOPE_1}\left(\frac{K_{C_{PM}}\ PPA}{\ell_{LE}}\right)\right)S_{REF}$$

where:

K_{INTC_1} - Value of $\Delta\left(\frac{PM}{qS_{REF}}\right)_{\alpha_1}$ at $\left(\frac{K_{C_{PM}}\ PPA}{\ell_{LE}}\right) = 0$, $\frac{ft.}{deg.}$, Figure 219.

$\Delta K_{INTC_{L/C}}$ - Intercept correction based on the ratio of store length to local chord, $\frac{L}{C_{LOCAL}}$, $\frac{ft.}{deg.}$, Figure 220.

K_{SLOPE_1} - Variation of $\Delta\left(\frac{PM}{qS_{REF}}\right)_{\alpha_1}$ with $\left(\frac{K_{C_{PM}}\ PPA}{\ell_{LE}}\right)$, $\frac{1}{in.\text{-}deg.}$, Figure 218.

$K_{C_{PM}}$ - Defined in Subsection 2.3.3, ft.

PPA - Plan projected area, see Subsection 2.2.2, in^2.

ℓ_{LE} - Distance from the nose of the installed store to the wing leading edge, measured in the wing plan view, in.

Break 2 (M_2):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_2} = K_{INTC_2} + K_{SLOPE_2}\left(\frac{K_{C_{PM}}\ PPA}{\ell_{LE}}\right)$$

where:

K_{INTC_2} - Value of $\Delta\left(\frac{PM}{q}\right)_{\alpha_2}$ at $\left(\frac{K_{C_{PM}} \; PPA}{\ell_{LE}}\right) = 0$, $\frac{ft.^3}{deg.}$, Figure 222.

K_{SLOPE_2} - Variation of $\Delta\left(\frac{PM}{q}\right)_{\alpha_2}$ with $\left(\frac{K_{C_{PM}} \; PPA}{\ell_{LE}}\right)$, $\frac{ft.^2}{in.-deg.}$, Figure 221.

$\frac{K_{C_{PM}} \; PPA}{\ell_{LE}}$ - Components of this term are defined under Break 1.

Break 3 (M_3):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_3} = K_{INTC_3} + K_{SLOPE_3}\left(\frac{K_{C_{PM}} \; PPA}{\ell_{LE}}\right)$$

where:

K_{INTC_3} - Value of $\left(\frac{PM}{q}\right)_{\alpha_3}$ at $\left(\frac{K_{C_{PM}} \; PPA}{\ell_{LE}}\right) = 0$, $\frac{ft.^3}{deg.}$, Figure 224.

K_{SLOPE_3} - Variation of $\Delta\left(\frac{PM}{q}\right)_{\alpha_3}$ with $\left(\frac{K_{C_{PM}} \; PPA}{LE}\right)$ $\frac{ft.^2}{in.-deg.}$, Figure 223.

$\frac{K_{C_{PM}} \; PPA}{\ell_{LE}}$ - Components of this term are defined under Break 1.

Knowing the incremental slopes at each break point, the calculation of $\left(\frac{PM}{q}\right)_{\alpha}$ at M=x is possible. The computation is based on a linear variation of $\left(\frac{PM}{q}\right)_{\alpha}$ between the break points where M=x occurs. From Figure 217 determine between which break points M=x occurs. Designate these as M_{LOW} and M_{HI} such that $M_{LOW} \leq x < M_{HI}$. If $x \leq M_0$ use the value of $\left(\frac{PM}{q}\right)_{\alpha}$ predicted in Subsection 3.4.1.1. Using the equation below $\left(\frac{PM}{q}\right)_{\alpha_{M=x}}$ can be computed.

$$\left(\frac{PM}{q}\right)_{\alpha_{M=x}} = \left(\frac{PM}{q}\right)_{\alpha_{PRED}} + \Delta\left(\frac{PM}{q}\right)_{\alpha_{LOW}} + \left(\frac{x-M_{LOW}}{M_{HI}-M_{LOW}}\right)\left[\Delta\left(\frac{PM}{q}\right)_{\alpha_{HI}} - \Delta\left(\frac{PM}{q}\right)_{\alpha_{LOW}}\right]$$

Example:

A numerical example of a similar computational procedure is included in Subsection 3.1.1.2.

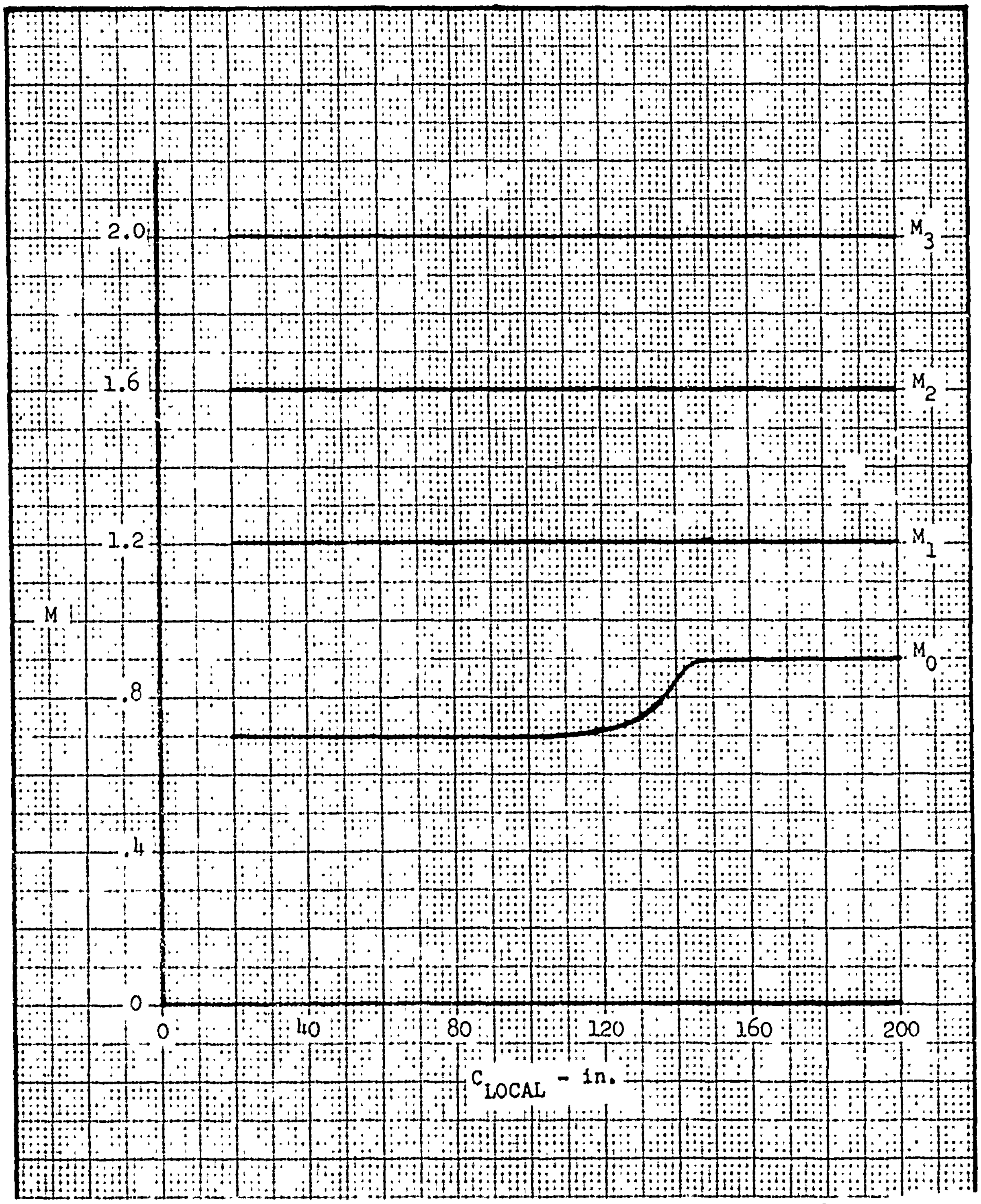

Figure 217. Pitching Moment Slope - Mach Number Break Points

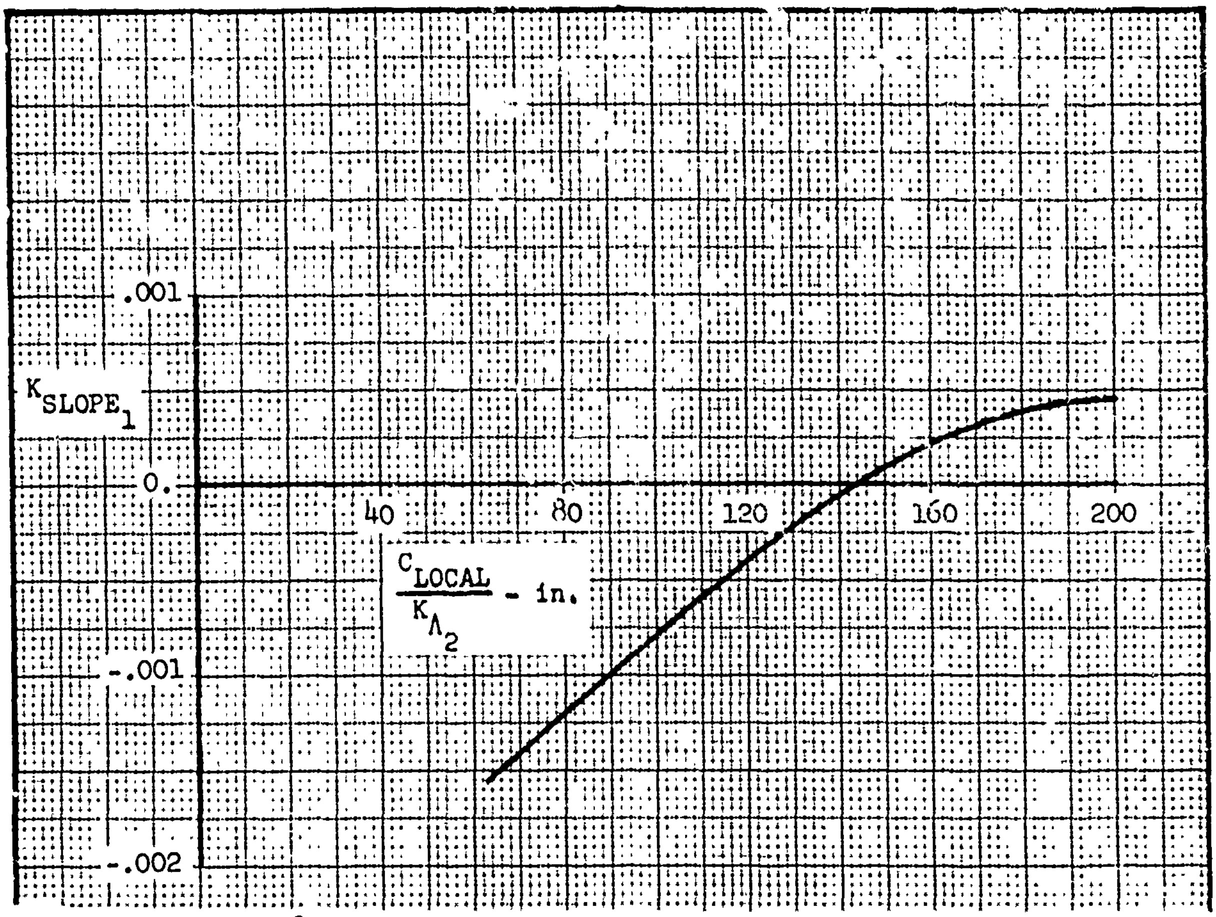

Figure 218. Pitching Moment Slope - K_{SLOPE} for Mach Break 1

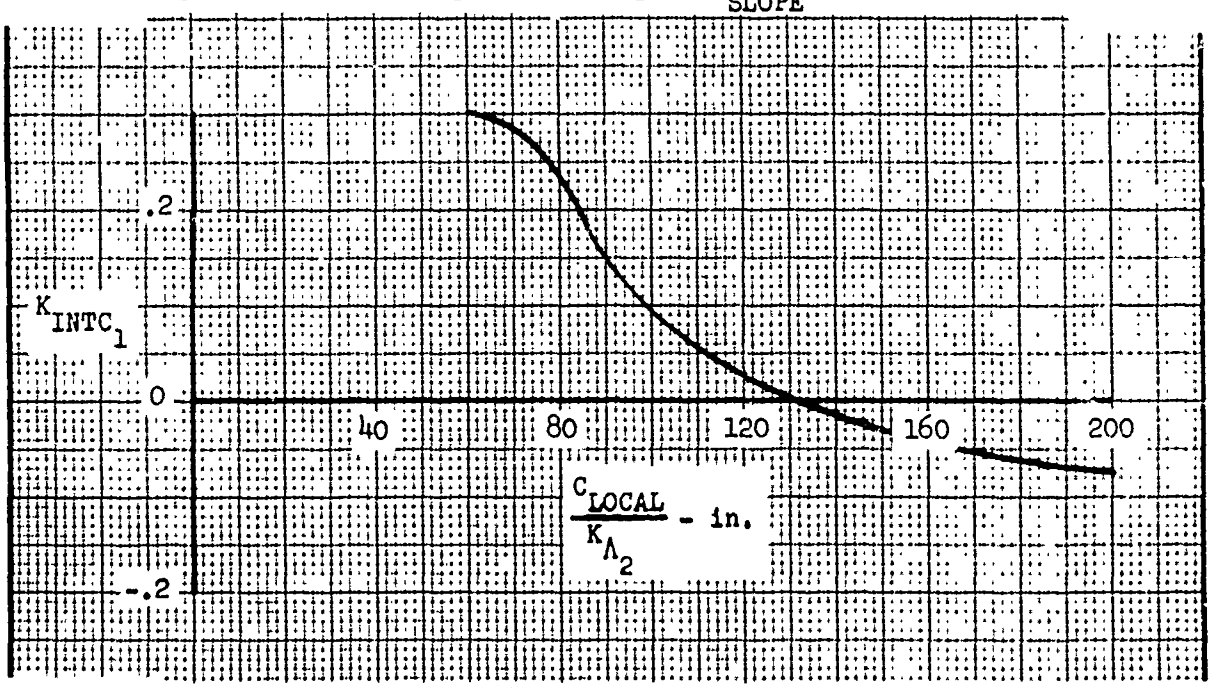

Figure 219. Pitching Moment Slope - K_{INTC} for Mach Break 1

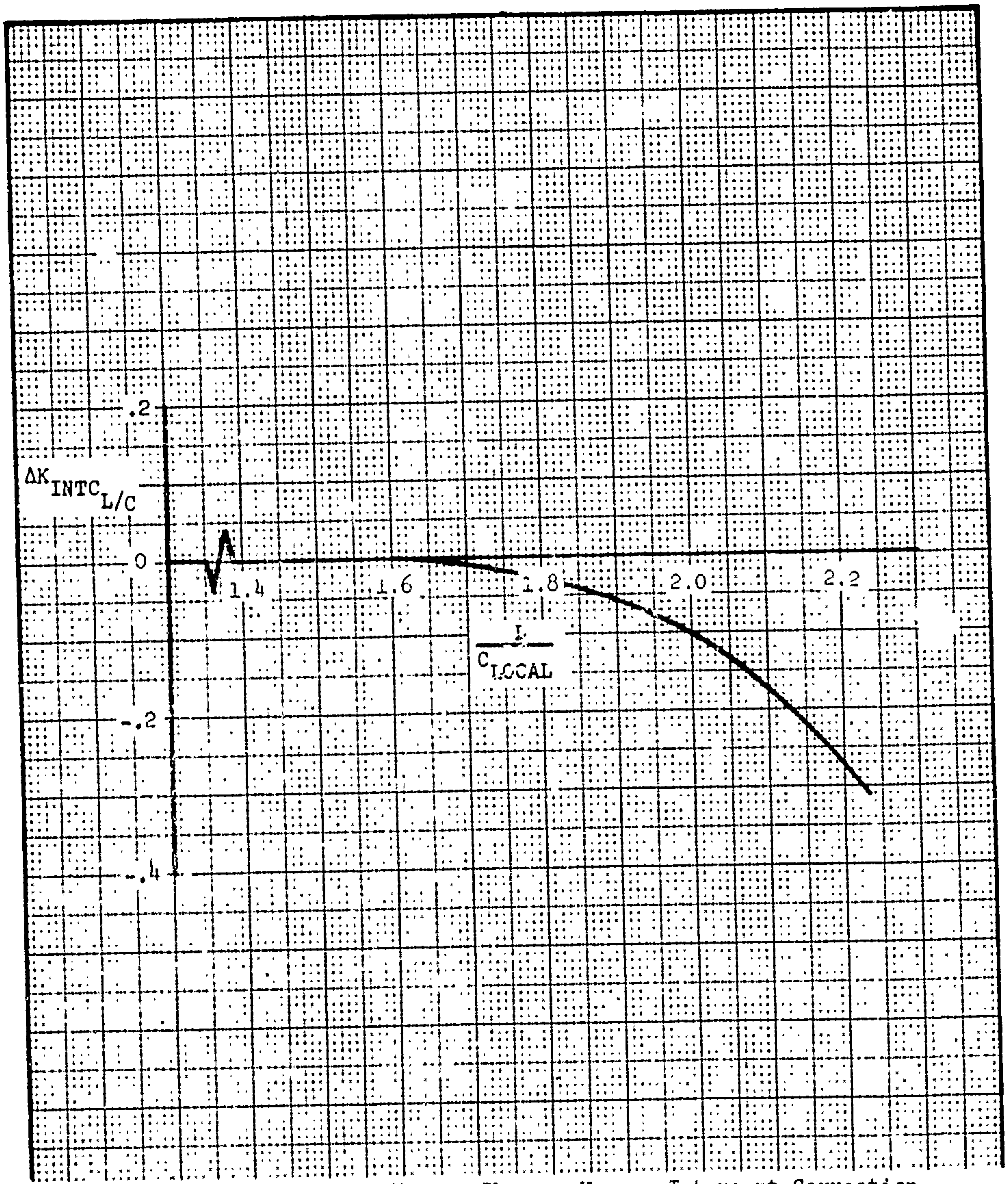

Figure 220. Pitching Moment Slope - K_{INTC_1} Intercept Correction

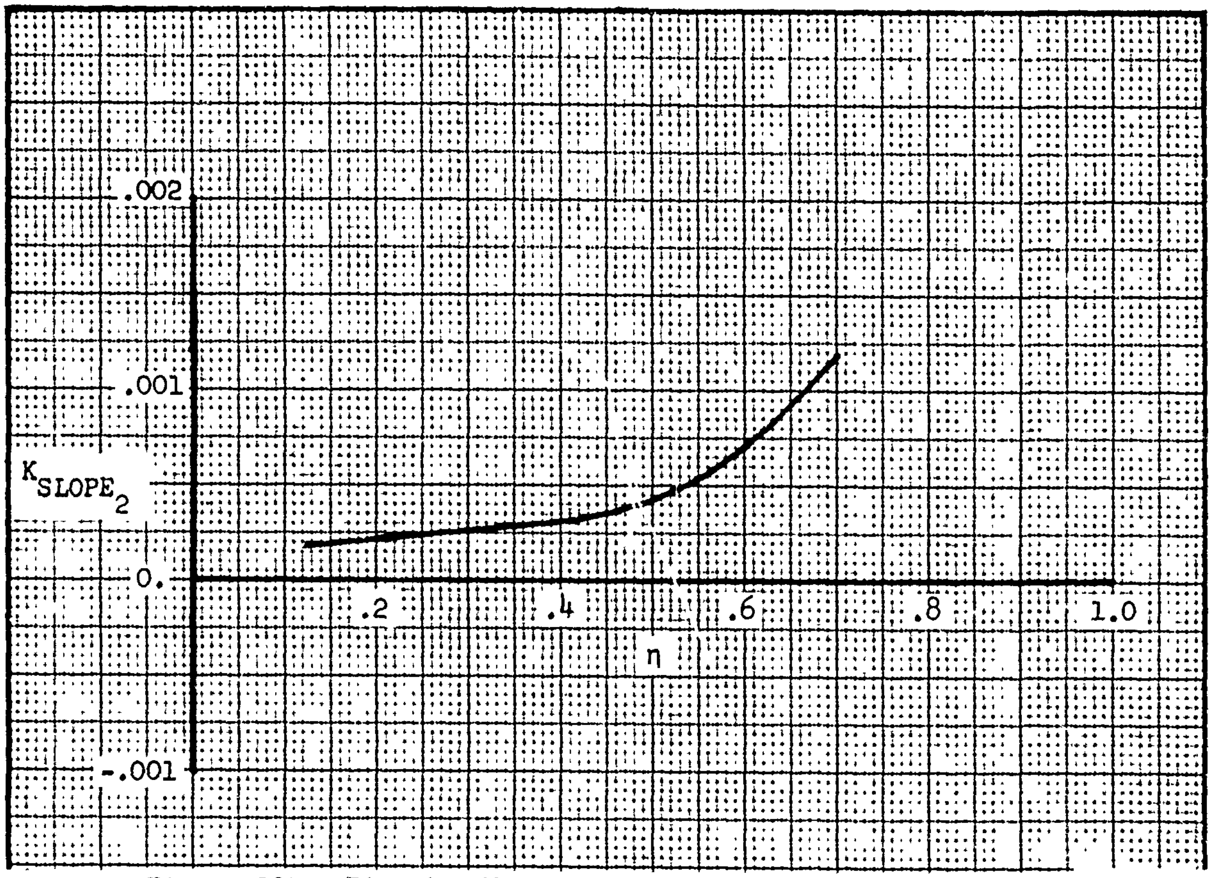

Figure 221. Pitching Moment Slope - K_{SLOPE} for Mach Break 2

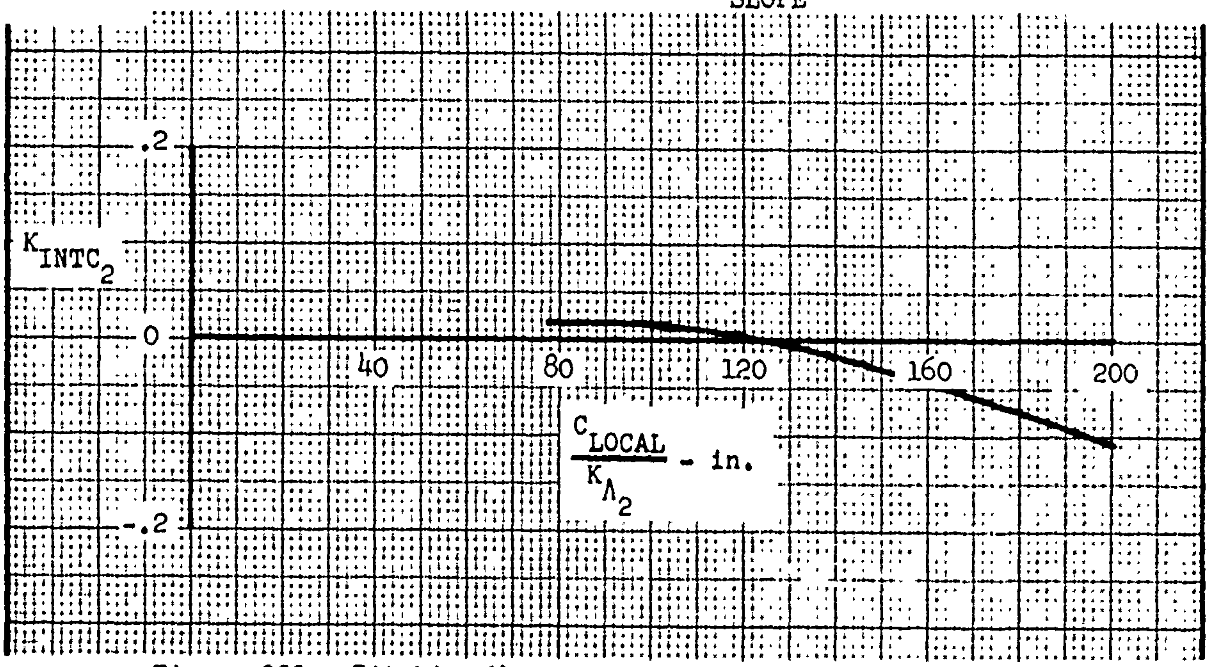

Figure 222. Pitching Moment Slope - K_{INTC} for Mach Break 2

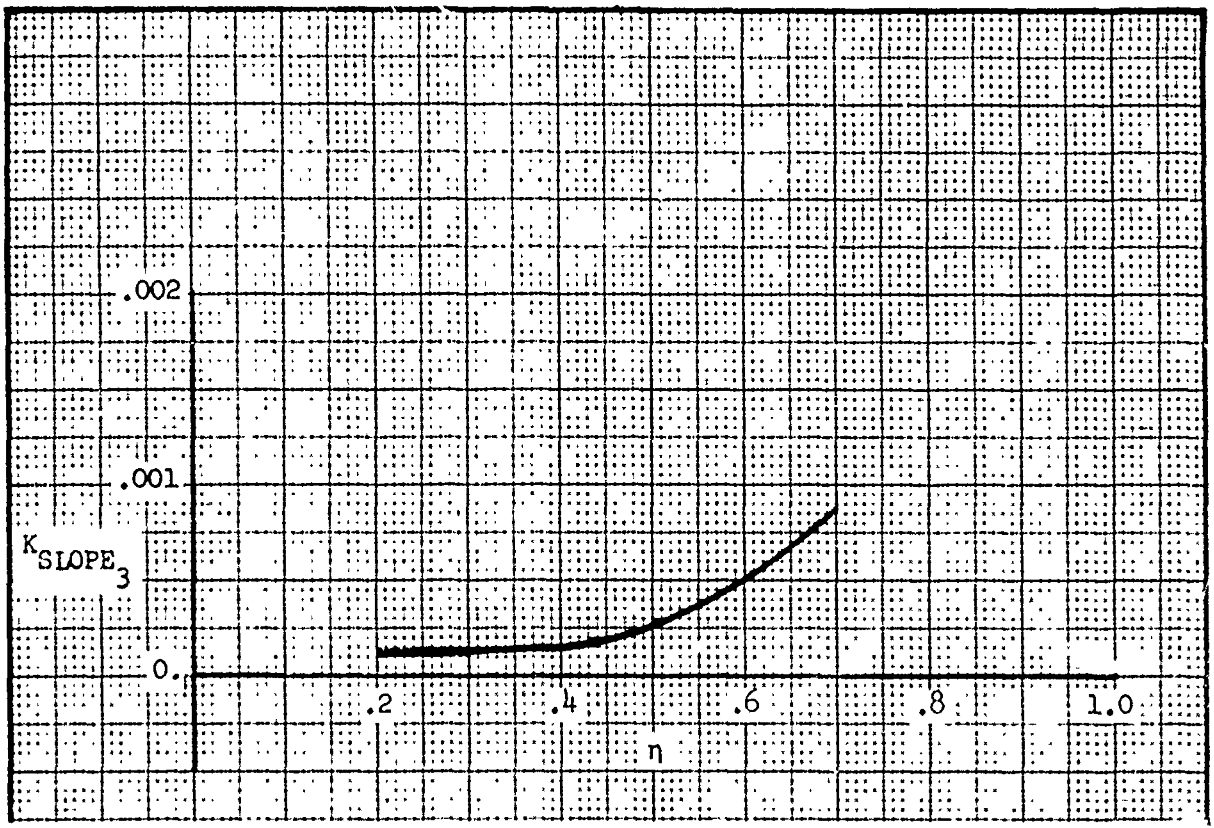

Figure 223. Pitching Moment Slope - K_{SLOPE} for Mach Break 3

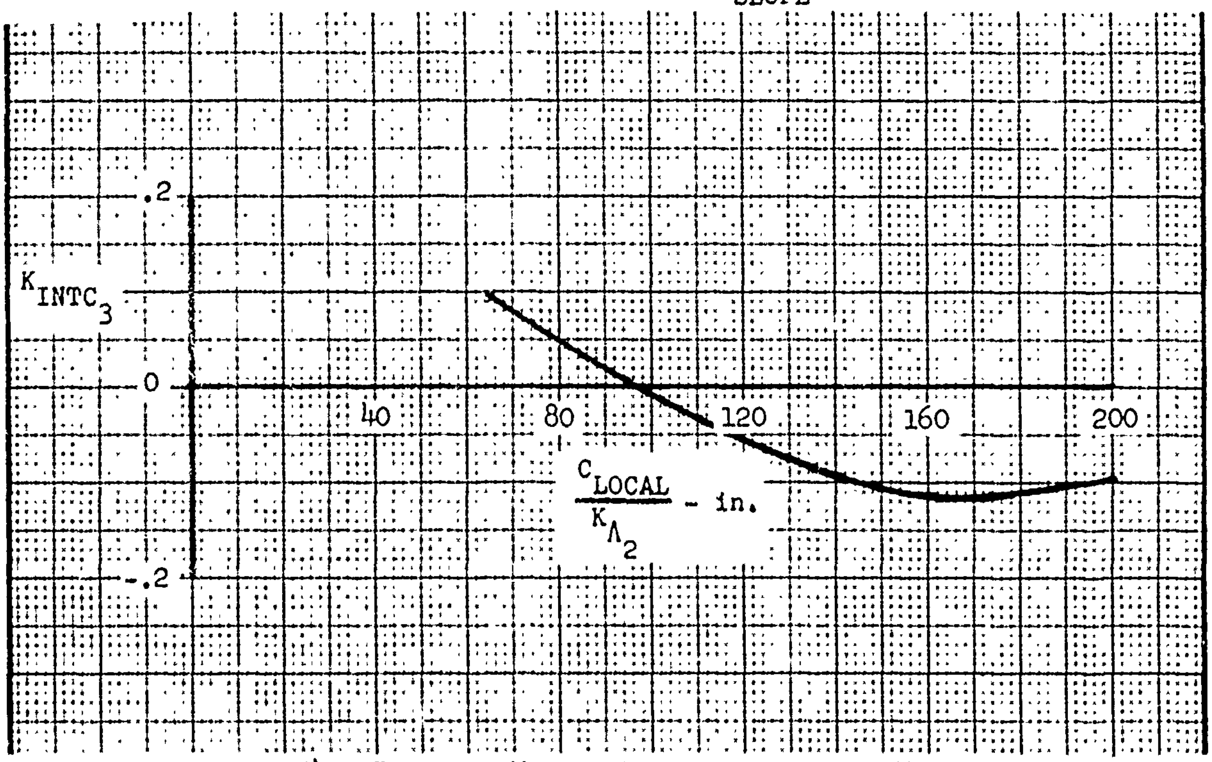

Figure 224. Pitching Moment Slope - K_{INTC} for Mach Break 3

3.4.1.3 Intercept Prediction

The value of $\left(\frac{PM}{q}\right)$ at $\alpha = 0$ is computed by the following expression.

$$\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\PRED}} = S_{REF}\,(K_{INTC_1} + K_{SLOPE_1}\,\ell_{LE})$$

where:

K_{INTC_1} - Value of $\left(\frac{PM}{qS_{REF}}\right)_{\alpha=0}$ at $\ell_{LE}=0$, ft., Figure 226.

K_{SLOPE_1} - Variation of $\left(\frac{PM}{qS_{REF}}\right)_{\alpha=0}$ with respect to ℓ_{LE}, $\frac{ft.}{in.}$, Figure 225.

ℓ_{LE} - Distance from the nose of the installed store to the leading edge of the wing measured in the wing plan view, in.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Example:

Compute $\left(\frac{PM}{q}\right)_{\alpha=0}$ for a 300-gallon tank on the A-7 center pylon at M=0.5

Required for Computation:

$C_{LOCAL} = 127.6$ in

$K_{\Lambda_2} = \frac{\cos 35^\circ}{\cos 45^\circ} = 1.158$

$\ell_{LE} = 75.1$ in.

$S_{REF} = 3.83$ ft^2.

$K_{INTC_1} = -4.95$ - Figure 226.

$K_{SLOPE_1} = .0465$ - Figure 225.

$$\left(\frac{PM}{q}\right)_{\substack{\alpha=0 \\ PhFD}} = 3.83\left(-4.95 + (.0465)(75.1)\right) = -5.6 \text{ ft}^3.$$

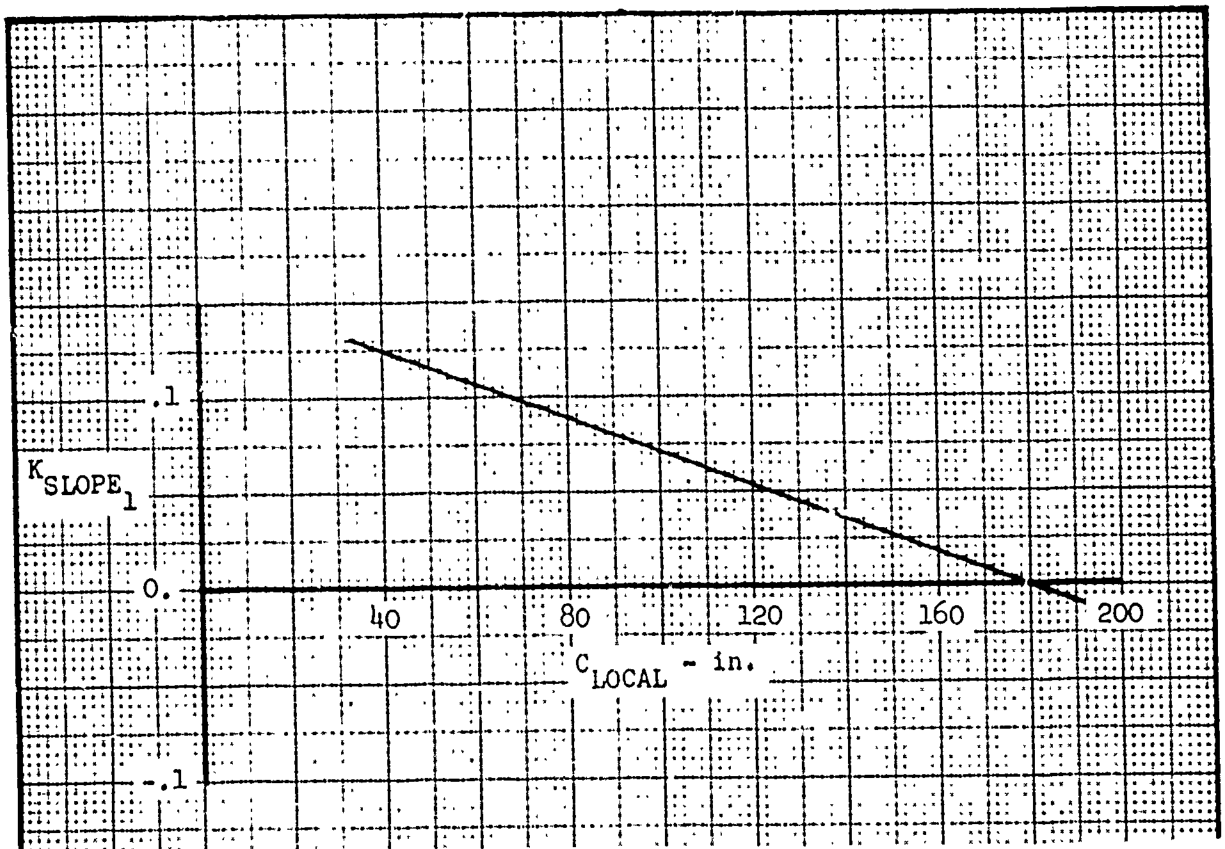

Figure 225. Pitching Moment Intercept - Variation with ℓ_{LE}

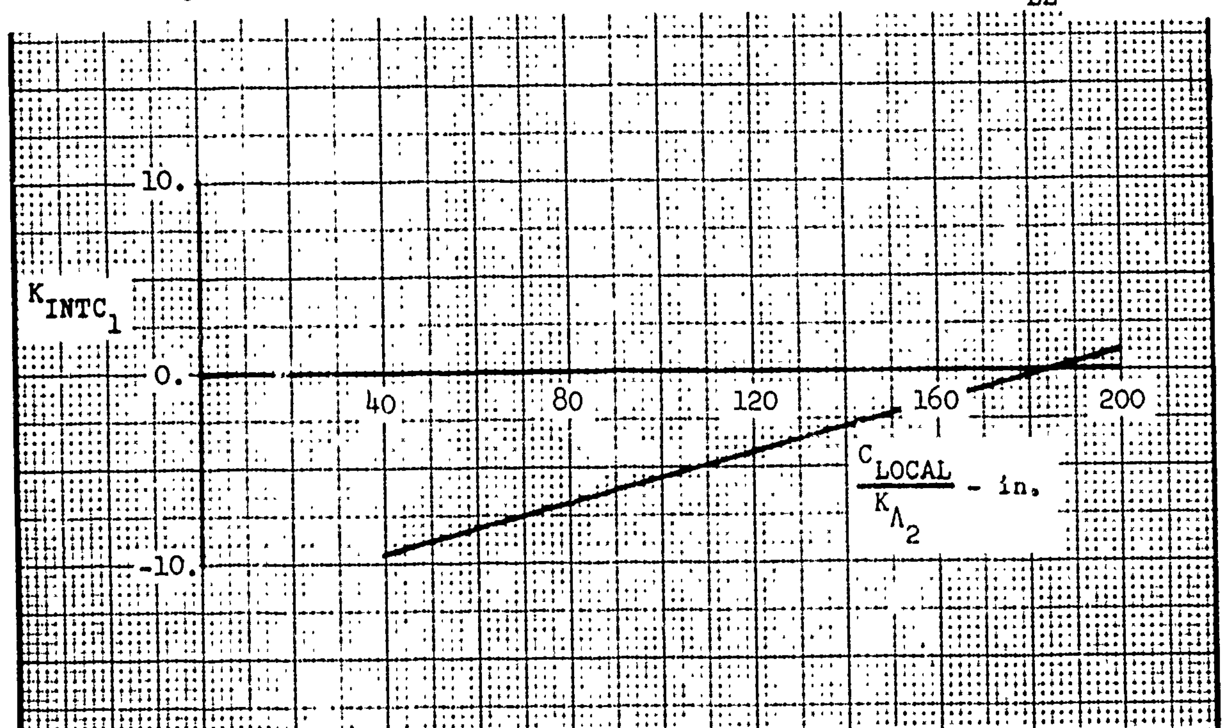

Figure 226. Pitching Moment Intercept - Value at $\ell_{LE} = 0$

3.4.1.4 Intercept Mach Number Correction

The variation of pitching moment intercept, $\left(\frac{PM}{q}\right)_{\alpha=0}$, between $M = 0.5$ and $M = 2.0$ is computed using the following expression:

$$\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{PM}{q}\right)_{\substack{\alpha=0\\PRED}} + \Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\M=x}}$$

where:

$\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\M=x}}$ is the increment in pitching moment intercept at M=x.

The basic approach to the prediction of the intercept variation with Mach is the same as presented in Subsection 3.4.1.2. That is, the variation is approximated by a series of straight line segments, as shown in Figure 216. The Mach numbers at which the slopes of the line segments change are designated break points. The variation of the Mach break points ($M_0 \rightarrow M_4$) is presented in Figure 227 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is again defined as the Mach number at which the intercept initially deviates from the predicted M = 0.5 value. Equations are presented below to compute the incremental intercept change at the remaining break points.

Break 1 (M_1):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha=0_1} = S_{REF}\left(K_{INTC_1} + K_{SLOPE_1}\left(\frac{K_{C_{PM}}\ PPA}{\ell_{LE}}\right)\right)$$

where:

K_{INTC_1} - Value of $\Delta\left(\frac{PM}{qS_{REF}}\right)_{\alpha=0_1}$ at $\frac{K_{C_{PM}}\ PPA}{\ell_{LE}} = 0$, ft., Figure 229.

K_{SLOPE_1} - Variation of $\Delta\left(\frac{PM}{qS_{REF}}\right)_{\alpha=0_1}$ with respect to $\left(\frac{K_{C_{PM}}\ PPA}{\ell_{LE}}\right)$

$\frac{1}{in.}$, Figure 228.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

$K_{C_{PM}}$ - Defined in Subsection 2.3.3, ft.

PPA - Plan projected area, see Subsection 2.2.2, in^2.

ℓ_{LE} - Distance from the nose of the installed store to the wing leading edge, measured in the wing plan view, in.

Break 2 (M_2):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha=0_2} = S_{REF}\left(K_\eta K_{INTC_2} + K_{SLOPE_2}\left(\frac{K_{C_{PM}} PPA\ L_n}{\ell_{LE} d}\right)\right)$$

where:

K_{INTC_2} - Value of $\Delta\left(\frac{PM}{qS_{REF}}\right)_{\alpha=0_2}$ at $\left(\frac{K_{C_{PM}} PPA\ L_n}{\ell_{LE} d}\right) = 0$ where $K_\eta = 1.0$, ft., Figure 231.

K_η - Spanwise correction factor to K_{INTC_2}, Figure 232.

K_{SLOPE_2} - Variation of $\Delta\left(\frac{PM}{qS_{REF}}\right)_{\alpha=0_2}$ with $\left(\frac{K_{C_{PM}} PPA\ L_n}{\ell_{LE} d}\right)$, $\frac{1}{in.}$, Figure 230.

L_n - Store nose length, in.

d - Store diameter, in.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

$\frac{K_{C_{PM}} PPA}{\ell_{LE}}$ - Components of this term are defined under Break 1.

Break 3 (M_3):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha=0_3} = S_{REF}\left(K_{INTC_3} + K_{SLOPE_3}\left(\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}\right)\right)$$

where:

K_{INTC_3} - Value of $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_3}$ at $\left(\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}\right) = 0$, ft., Figure 234.

K_{SLOPE_3} - Variation of $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_3}$ with $\left(\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}\right)$, $\frac{1}{in.}$, Figure 233.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

$\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}$ - Components of this term are defined under Break 1.

Break 4 (M_4):

$$\Delta\left(\frac{PM}{q}\right)_{\alpha=0_4} = S_{REF}\left(K_{INTC_4} + K_{SLOPE_4}\left(\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}\right)\right)$$

where:

K_{INTC_4} - Value of $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_4}$ at $\left(\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}\right) = 0$, ft., Figure 236.

K_{SLOPE_4} - Variation of $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_4}$ with $\left(\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}\right)$, $\frac{1}{in.}$, Figure 235

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

$\frac{K_{C_{PM}}\,PPA}{\ell_{LE}}$ - Components of this term are defined under Break 1.

To calculate $\left(\frac{PM}{q}\right)_{\alpha=0}$ at $M = x$, determine from Figure 227 the break points between which $M = x$ occurs. Designate these as M_{LOW} and M_{HI} such that $M_{LOW} \leq x < M_{HI}$. If $x \leq M_0$, the value of $\left(\frac{PM}{q}\right)_{\alpha=0}$ predicted in Section Subsection 3.4.1.3 will apply. Using the expression below $\frac{PM}{q}\,{}_{\substack{\alpha=0\\M=x}}$ can be computed.

$$\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{PM}{q}\right)_{\substack{\alpha=0\\PRED}} + \Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\LOW}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)\left[\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\HI}} - \Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\LOW}}\right]$$

A numerical example of a similar computational procedure is included in Subsection 3.1.1.2.

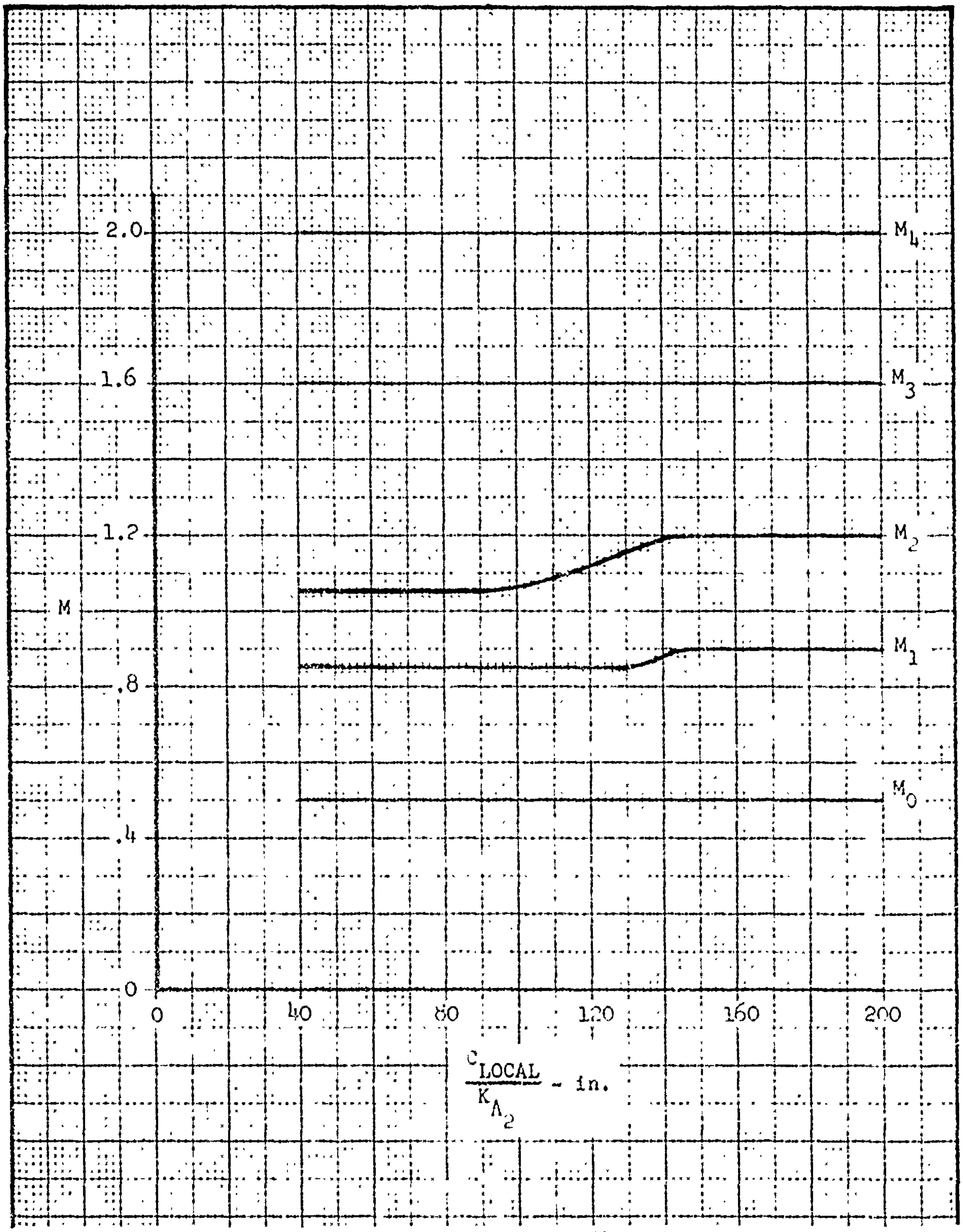

Figure 227. Pitching Moment Intercept - Mach Number Break Points

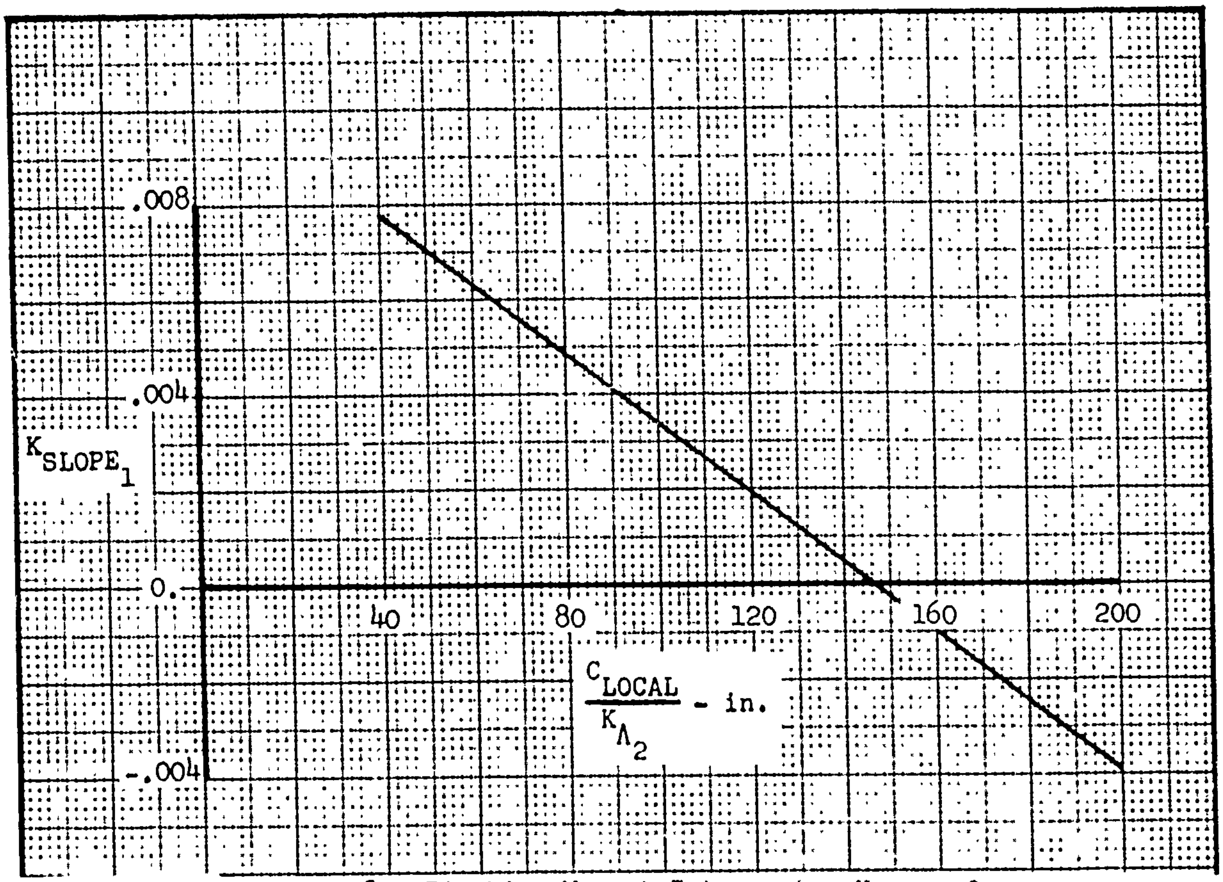

Figure 228. Pitching Moment Intercept - K_{SLOPE} for Mach Break 1

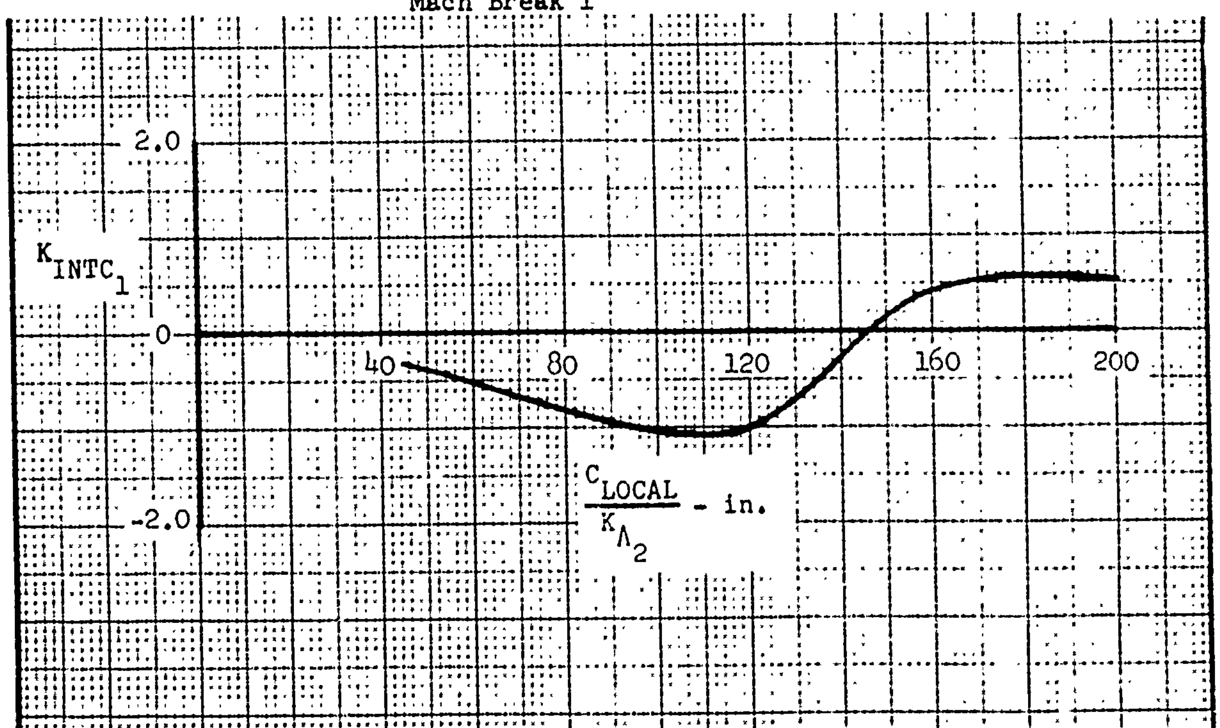

Figure 229. Pitching Moment Intercept - K_{INTC} for Mach Break 1

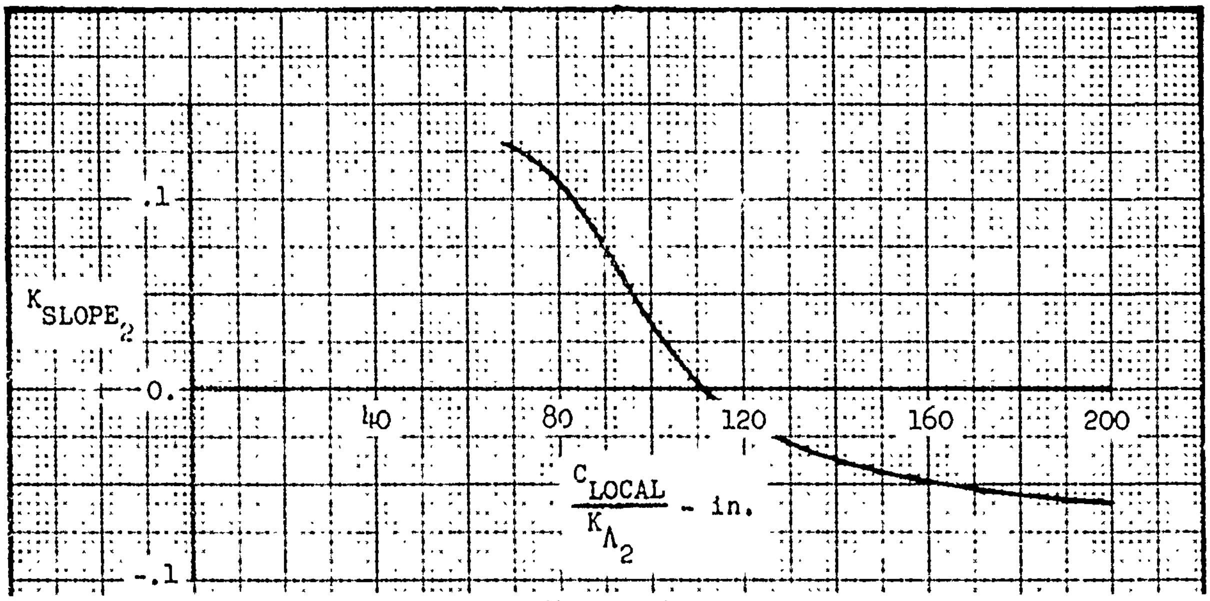

Figure 230. Pitching Moment Intercept - K_{SLOPE} for Mach Break 2

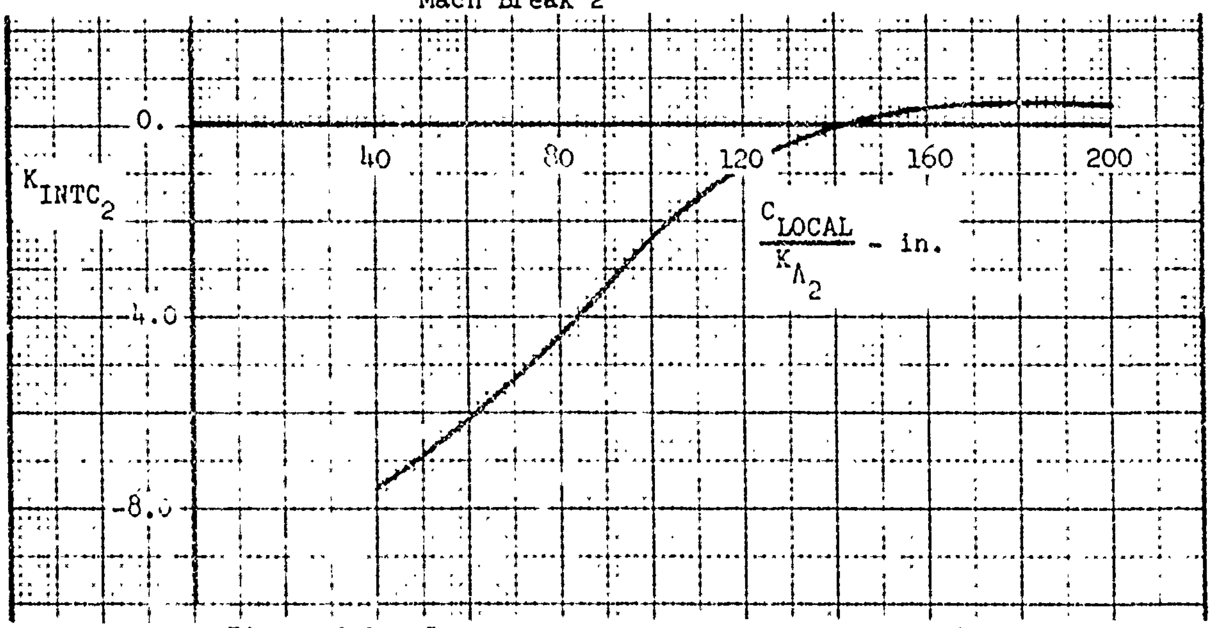

Figure 231. Pitching Moment Intercept - K_{INTC} for Mach Break 2

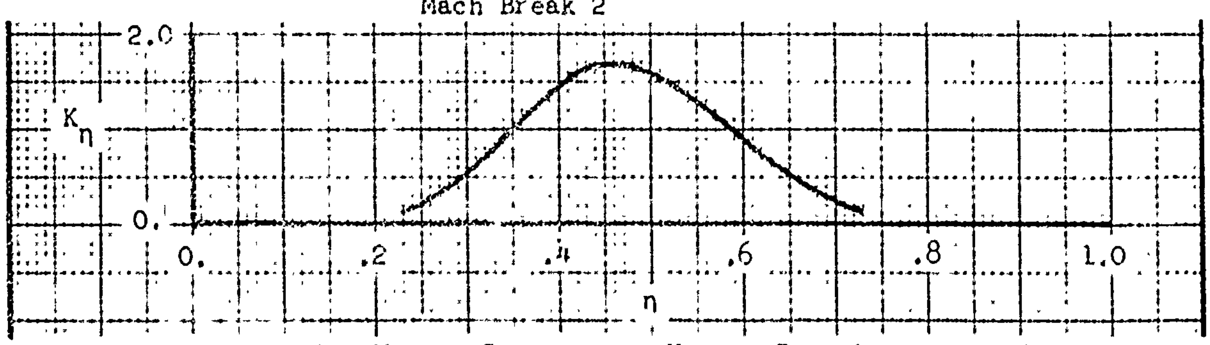

Figure 232. Pitching Moment Intercept - K_{INTC_2} Spanwise Correction Factor

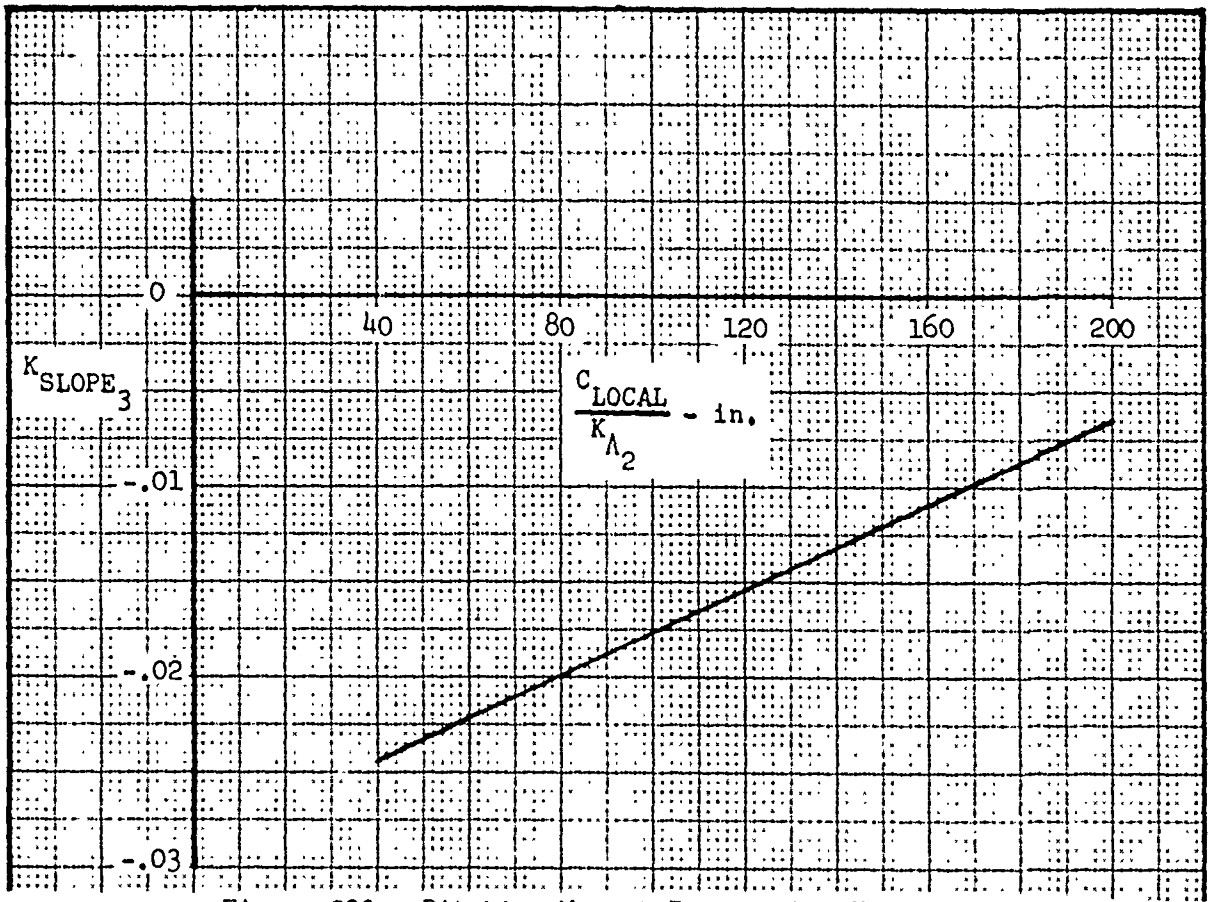

Figure 233. Pitching Moment Intercept - K_{SLOPE} for Mach Break 3

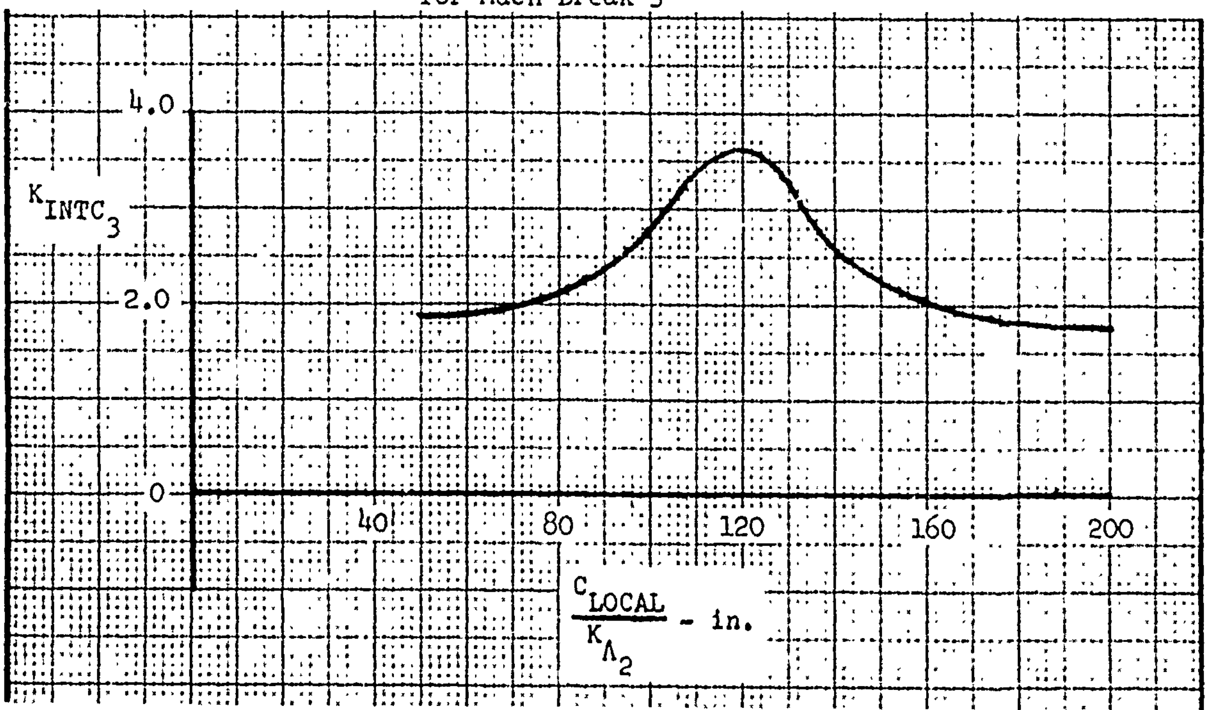

Figure 234. Pitching Moment Intercept - K_{INTC} for Mach Break 3

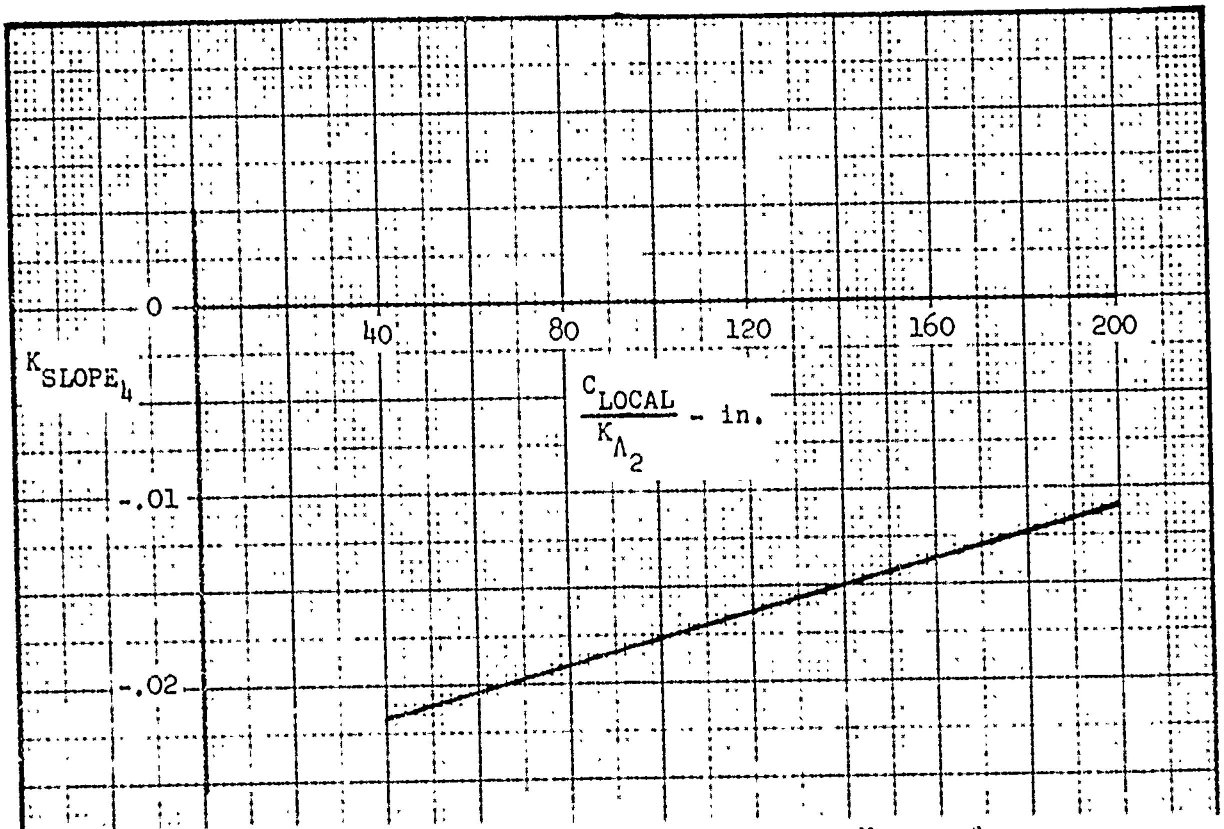

Figure 235. Pitching Moment Intercept - K_{SLOPE} for Mach Break 4

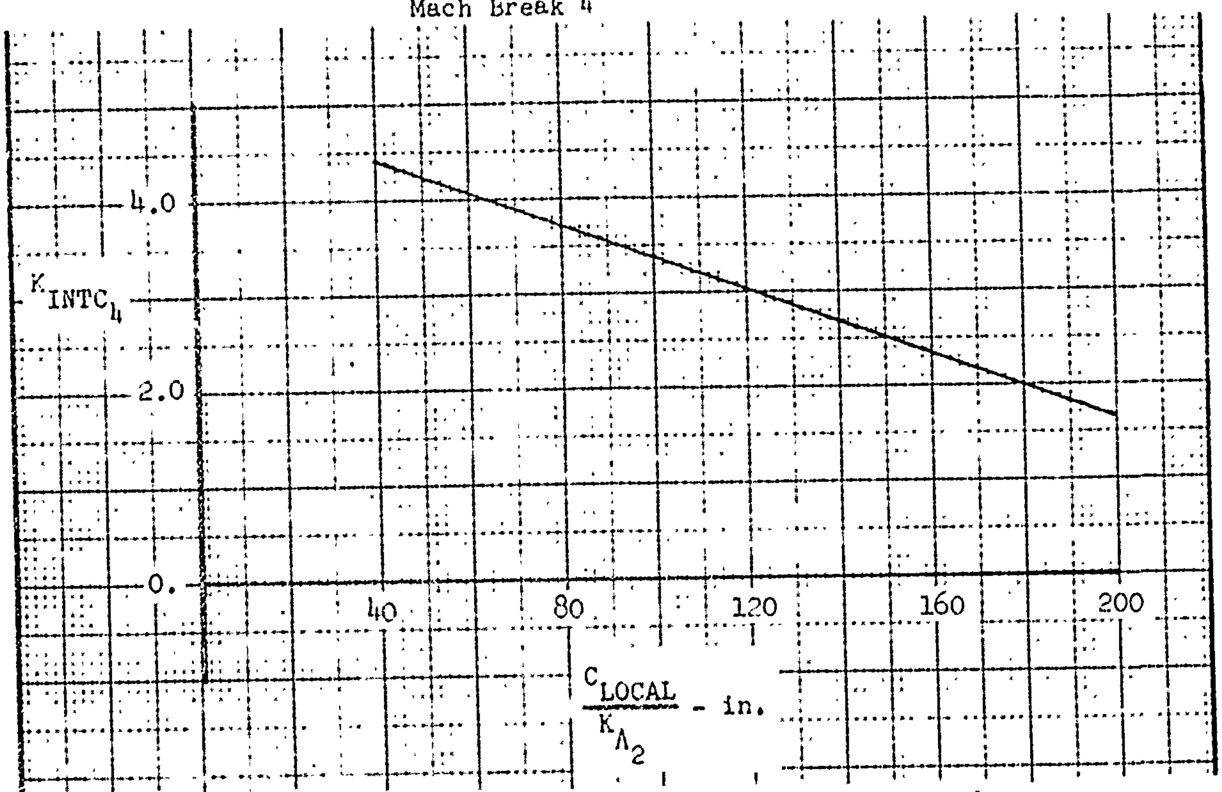

Figure 236. Pitching Moment Intercept - K_{INTC} for Mach Break 4

3.4.2 Increment-Aircraft Yaw

The development of equations for predicting the incremental pitching moment slope and the incremental pitching moment intercept is similar to that of side force as described in Subsection 3.1.2.

3.4.2.1 Slope Prediction

The equation used to predict the incremental pitching moment slope per degree β_S, $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$, at M = 0.5 is as follows.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental C_{m_α} per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg^2.}$, Figure 237.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in. - deg^2.}$, Figure 238.

$\frac{ADJ.PPA}{L}$ - Store adjusted plan projected area divided by store length, in.

K_{INTC_1} - Value of $\Delta C_{m_{\alpha_{\beta_S}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2.}$, Figure 239.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2.}$, Figure 240.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

Example: Calculate $\Delta\left(\frac{PM}{q}\right)_\alpha$ for a 300-gallon tank on the A-7 center pylon at M = 0.5 and $\beta_S = +4°$.

Required for Computation:

$d = 2.2$ ft.

$S_{REF} = 3.85$ ft^2.

$\eta' = .27$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda} = 1.158$

$ADJ.PPA = 13610$ in^2. from Subsection 2.5.3.

$l = 226$ in.

$K_{CLOPE_1} = .00052$ - Figure 237,+ β_S curve

$\Delta K_{SLOPE_{INTF}} = 0.0$- Figure 238,+ β_S curve

$K_{INTC_1} = -.018$ - Figure 239,+ β_S curve

$\Delta K_{INTC_{INTF}} = 0.0$ - Figure 240, + β_S curve

Substituting,

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}} = [(.00052 + 0.0)(60.3) + (-.018) + 0.0]8.43$$

$$= .1126 \frac{ft^2}{deg^2}.$$

and using the equation of Subsection 3.4.2.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha} = \Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}} \cdot \beta_S$$

$$= (.1126)(4) = .45 \quad \frac{ft^3.}{deg.}$$

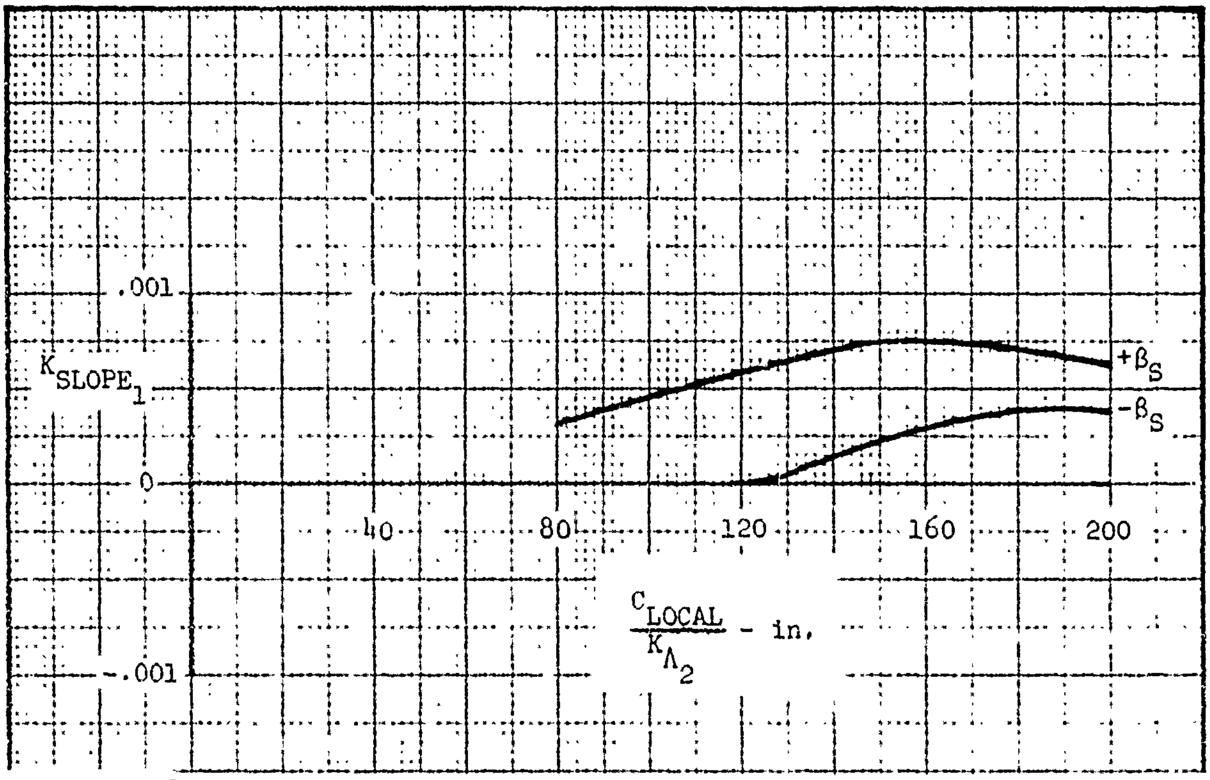

Figure 237. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

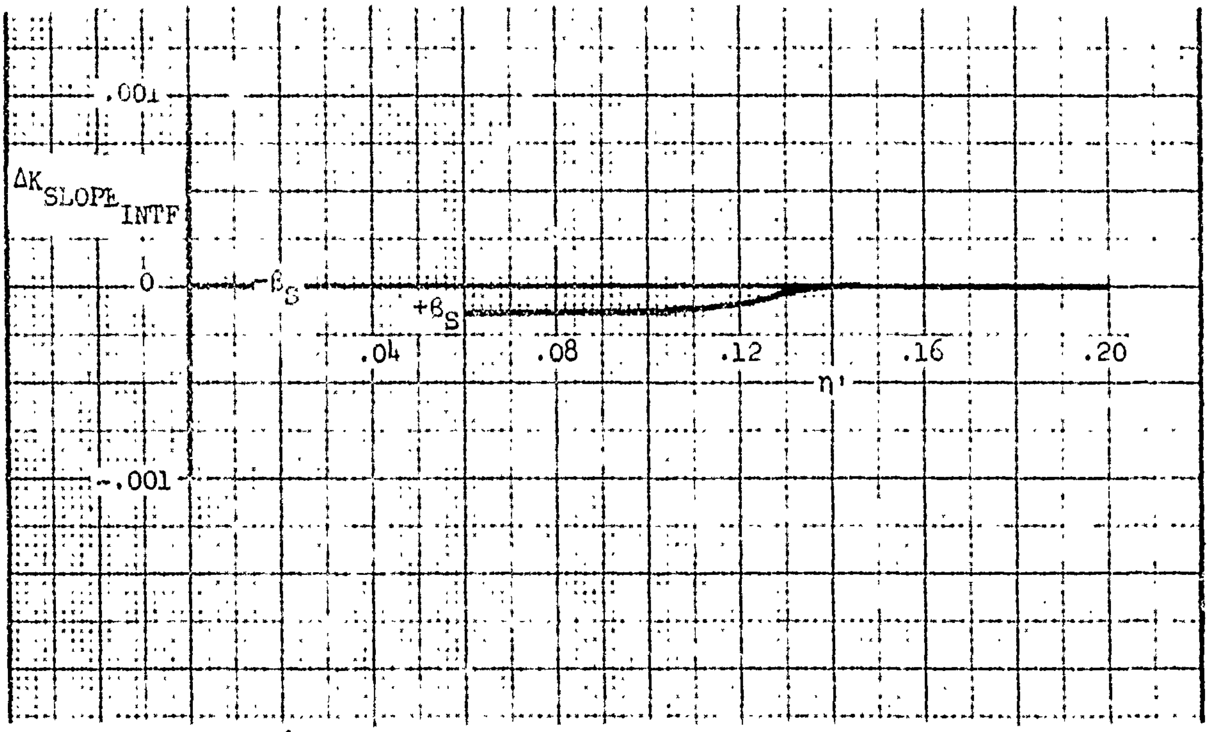

Figure 238. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

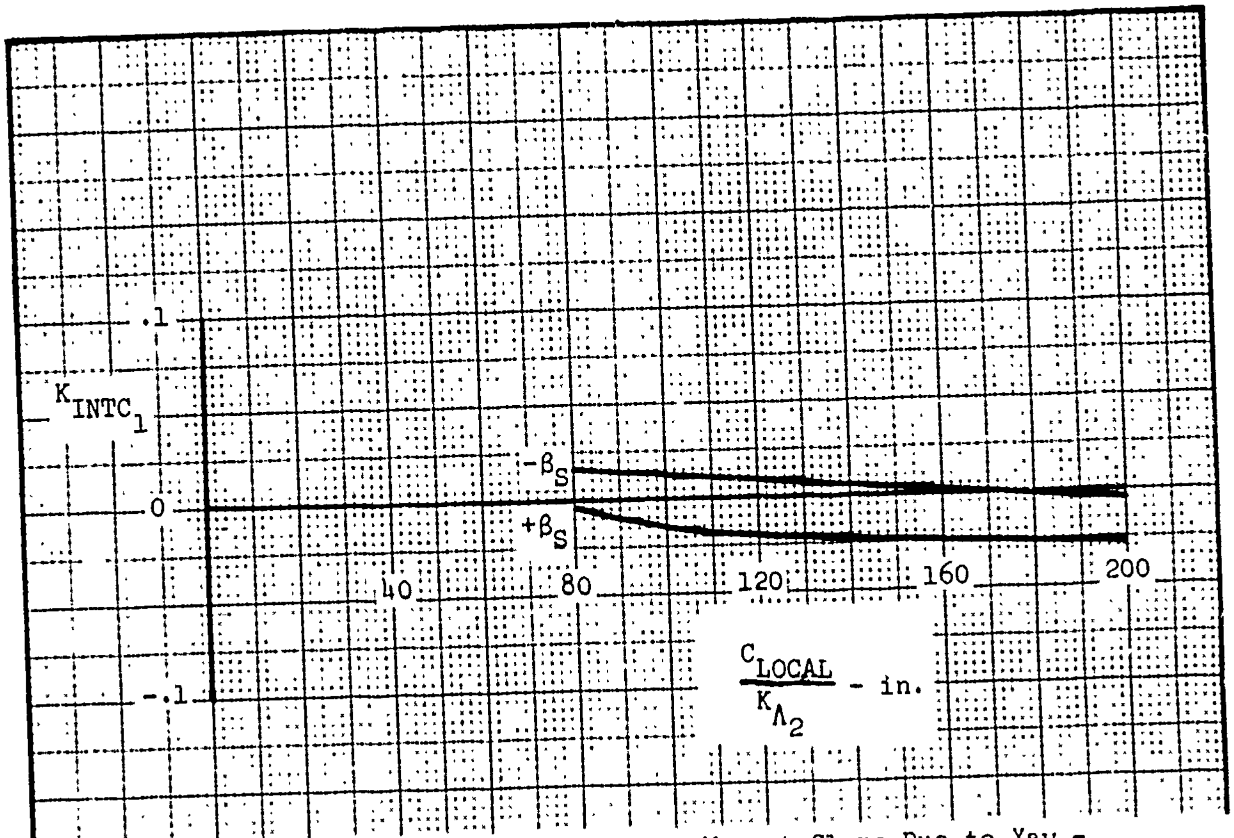

Figure 239. Incremental Pitching Moment Slope Due to Yaw - K_{INTC} for Positive and Negative Store Yaw

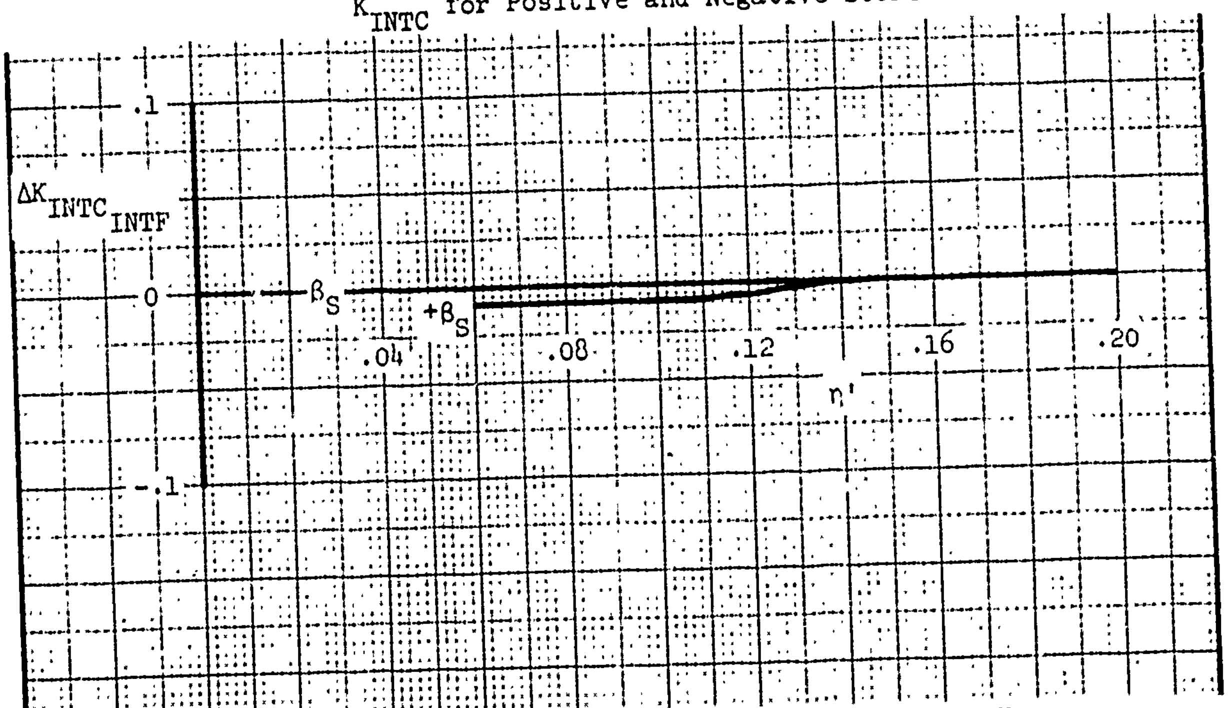

Figure 240. Incremental Pitching Moment Slope Due to Yaw - K_{INTC_1} Fuselage Interference Correction

3.4.2.2 Slope Mach Number Correction

To compute the variation in incremental pitching moment slope per degree β_S, $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$, between M=0.5 and M = 2.0, use the following relation.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}} = \Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$$

where:

$\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}}$ - incremental pitching moment slope per degree β_S at M = 0.5 from Subsection 3.4.2.1.

$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}}$ - Incremental change with Mach number of the incremental pitching moment slope per degree β_S at M = 0.5.

The procedure for calculating the Mach number correction for incremental pitching moment slope per degree β_S is the same as that found in Subsection [illegible] for the incremental yawing moment slope per degree β_S Mach number correction.

The incremental pitching moment slope per degree β_S variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, M_3, and M_4 as in Figure [illegible].

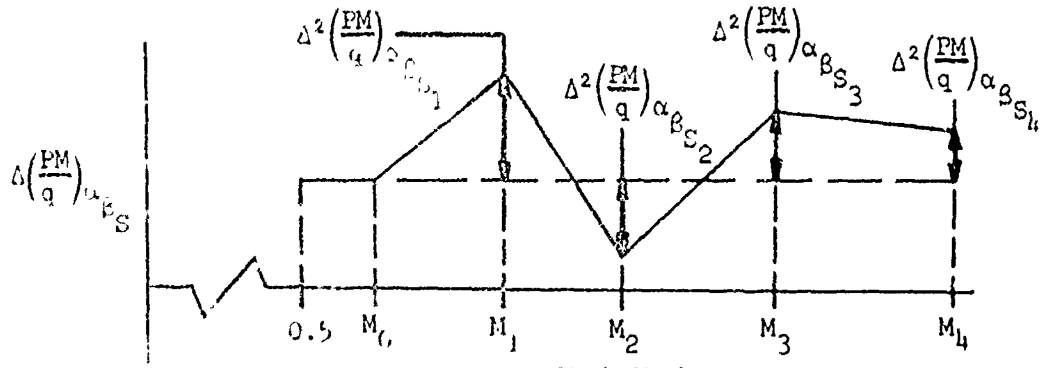

Figure [illegible]. Incremental Pitching Moment Slope Due to Yaw - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figure 242 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is the Mach number where the incremental slope initially deviates from the value predicted at M = 0.5. Equations to predict the incremental changes at the remaining Mach break points from the initial value at M = 0.5 are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_1}}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF_1}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF_1}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental $C_{m_{\alpha_1}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in - deg^2}$, Figure 243.

$\Delta K_{SLOPE_{INTF_1}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{in. - deg^2}$, Figure 244.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.4.2.1.

K_{INTC_1} - Value of $\Delta C_{m_{\alpha_{\beta_{S_1}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2}$, Figure 245.

$\Delta K_{INTC_{INTF_1}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2}$, Figure 246.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft².

d - Store diameter, ft.

Break 2 (M_2):

$$\Delta^2\left(\frac{\Delta H}{q}\right)_{\alpha_{\beta_{S_2}}} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF_2}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2} + \Delta K_{INTC_{INTF_2}}]S_{REF}d$$

where:

K_{SLOPE_2} - Variation of incremental $C_{m_{\alpha_2}}$ per degree β_2 with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg^2.}$, Figure 247.

$\Delta K_{SLOPE_{INTF_2}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{in. - deg^2.}$, Figure 248.

$\frac{ADJ.PPA}{L}$ - Defined in Section 3.4.2.1.

K_{INTC_2} - Value of $\Delta C_{m_{\alpha_{\beta_{S_2}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2.}$, Figure 249.

$\Delta K_{INTC_{INTF_2}}$ - Incremental change in K_{INTC_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2.}$, Figure 250.

Break 3 (M_3):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_3}}} = [(K_{SLOPE_3} + \Delta K_{SLOPE_{INTF_3}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_3} + \Delta K_{INTC_{INTF_3}}]S_{REF}d$$

where:

K_{SLOPE_3} - Variation of incremental $C_{m_{\alpha_3}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in - deg^2.}$, Figure 251.

$\Delta K_{SLOPE_{INTF_3}}$ - Incremental change in K_{SLOPE_3} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{in. - deg^2.}$, Figure 252.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.4.2.1.

K_{INTC_3} - Value of $\Delta C_{m_{\alpha_{\beta_{S_3}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2.}$, Figure 253.

$\Delta K_{INTC_{INTF_3}}$ - Incremental change in K_{INTC_3} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2.}$, Figure 254.

Break 4 (M_4):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_4}}} = [(K_{SLOPE_4} + \Delta K_{SLOPE_{INTF_4}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4} + \Delta K_{INTC_{INTF_4}}]S_{REF}d$$

where:

K_{SLOPE_4} - Variation of incremental $C_{m_{\alpha_4}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in - deg^2.}$, Figure 255.

$\Delta K_{SLOPE_{INTF_4}}$ - Incremental change in K_{SLOPE_4} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{in. - deg^2.}$, Figure 256.

$\frac{ADJ.PPA}{L}$ - Defined in Section 3.4.2.1.

K_{INTC_4} - Value of $\Delta C_{m_{\alpha_{\beta_{S_4}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg^2.}$, Figure 257.

$\Delta K_{INTC_{INTF_4}}$ - Incremental change in K_{INTC_4} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg^2.}$, Figure 258.

To compute $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$ at M = x, first determine from Figure 242 between which Mach number break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Then compute $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$ at M = x from the expression below.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=x}}}} = \Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M_{LOW}}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right) \left| \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M_{HI}}}}} - \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{\beta_{S_{M_{LOW}}}}} \right|$$

If $x > M = 1.6$, then $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$ at $M = x$ is equal to the value of $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$ at $M = 1.6$.

If $x \leq M_0$, then $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$ at $M = x$ is equal to the value of $\Delta\left(\frac{PM}{q}\right)_{\alpha_{\beta_S}}$ at $M = 0.5$ (the initial term of the above equation from Subsection 3.4.2.1).

A numerical example illustraing the use of the above equation is included in Subsection 3.2.2.2.

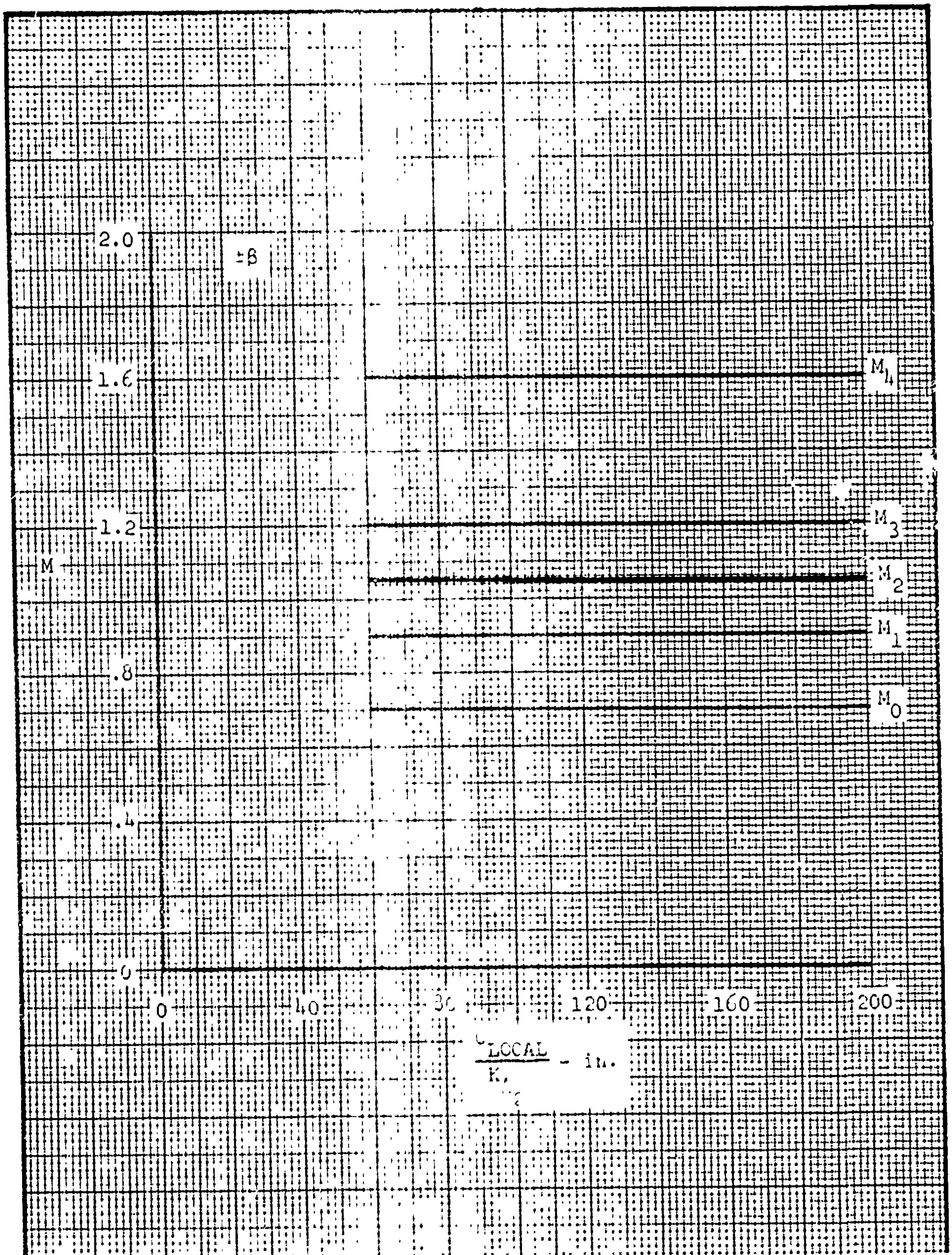

Figure 242. Incremental Pitching Moment Slope Due to Yaw - Mach Number Break Points for Positive and Negative Store Yaw

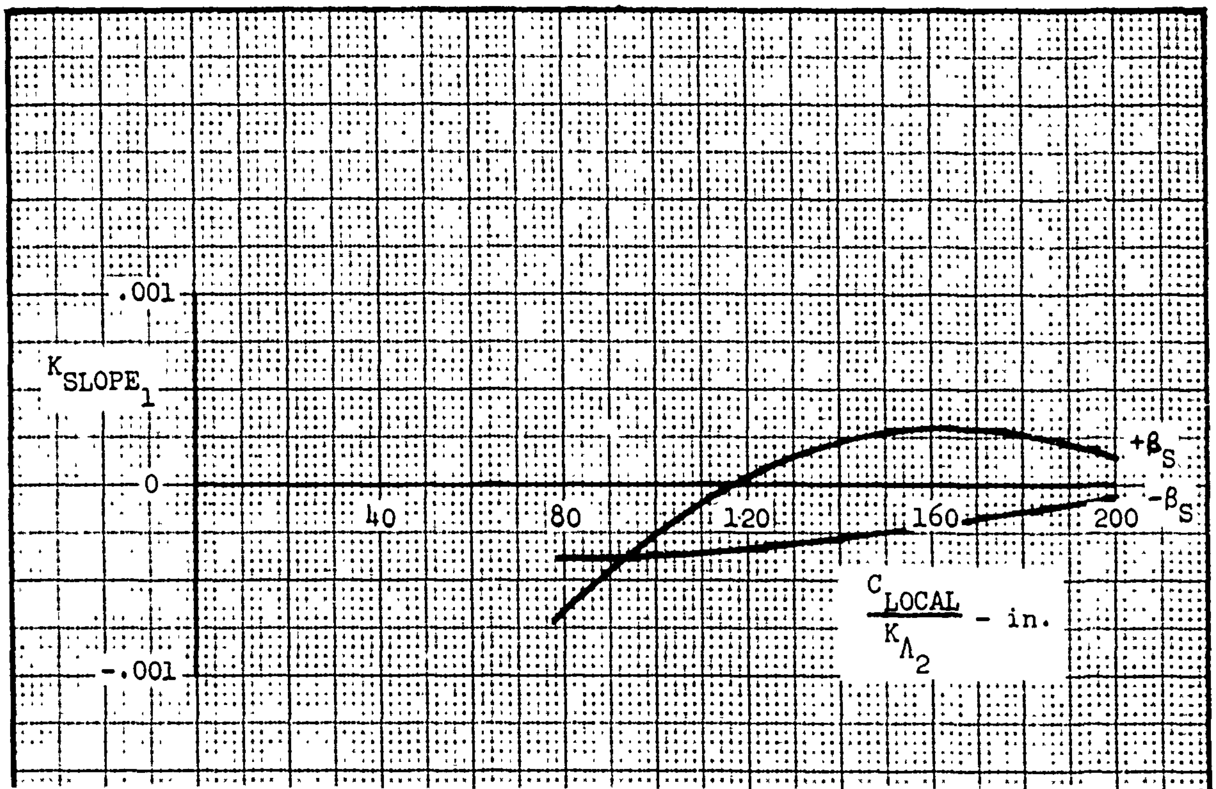

Figure 243. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE} for Mach Break 1

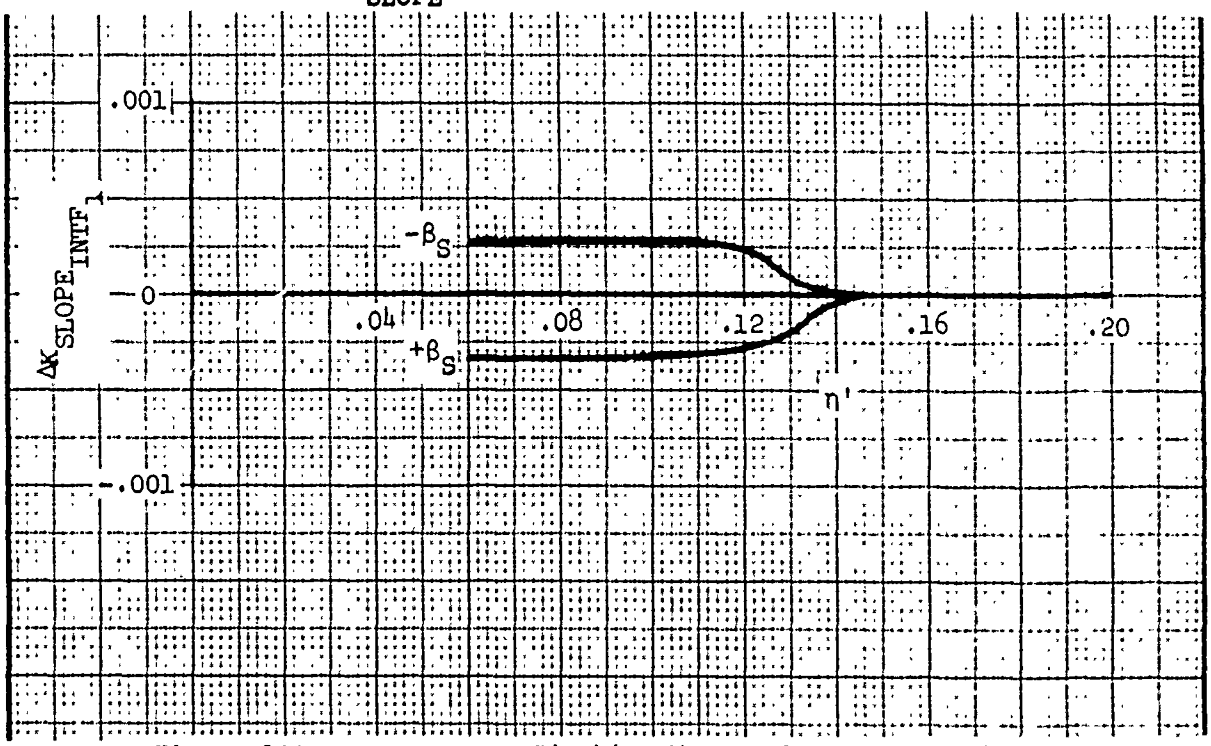

Figure 244. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

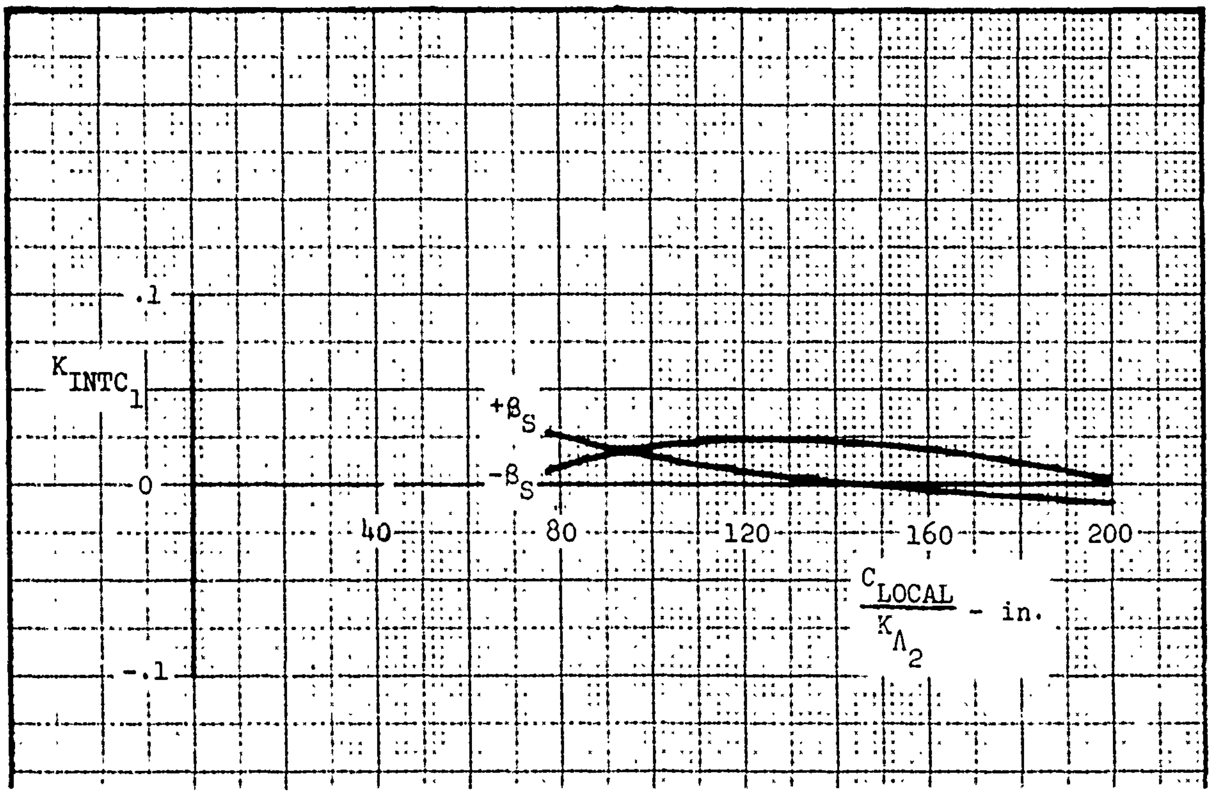

Figure 245. Incremental Pitching Moment Slope Due to Yaw - K_{INTC} for Mach Break 1

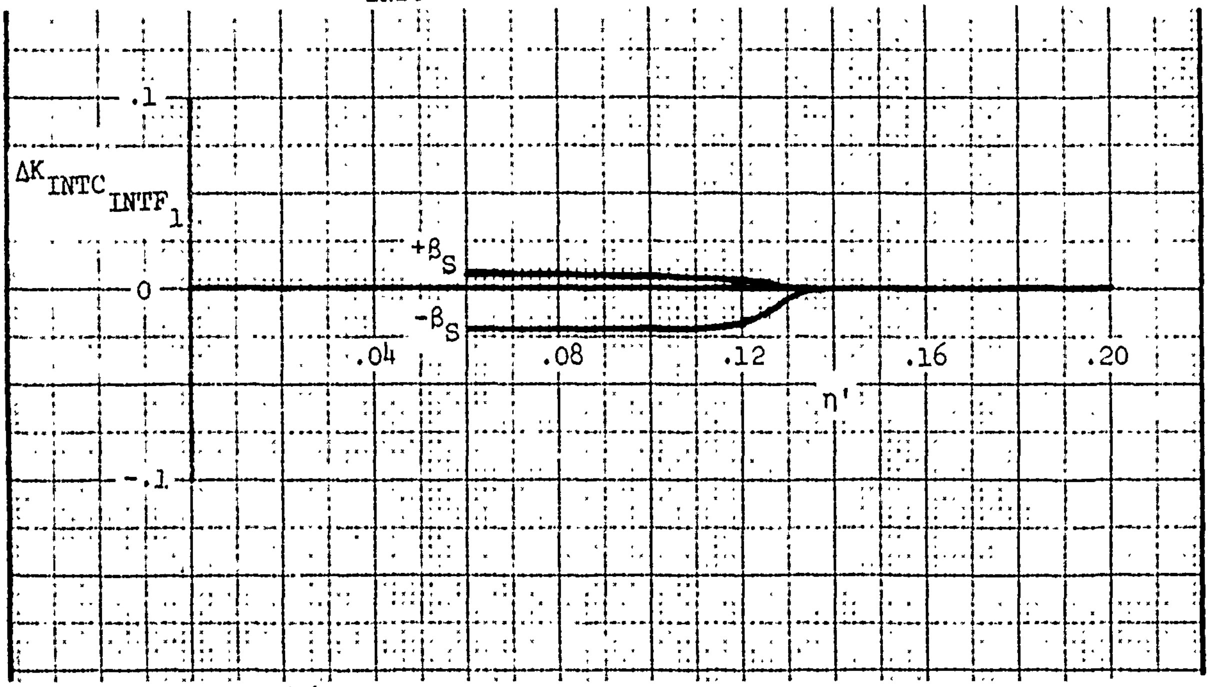

Figure 246. Incremental Pitching Moment Slope Due to Yaw - K_{INTC_1} Fuselage Interference Correction

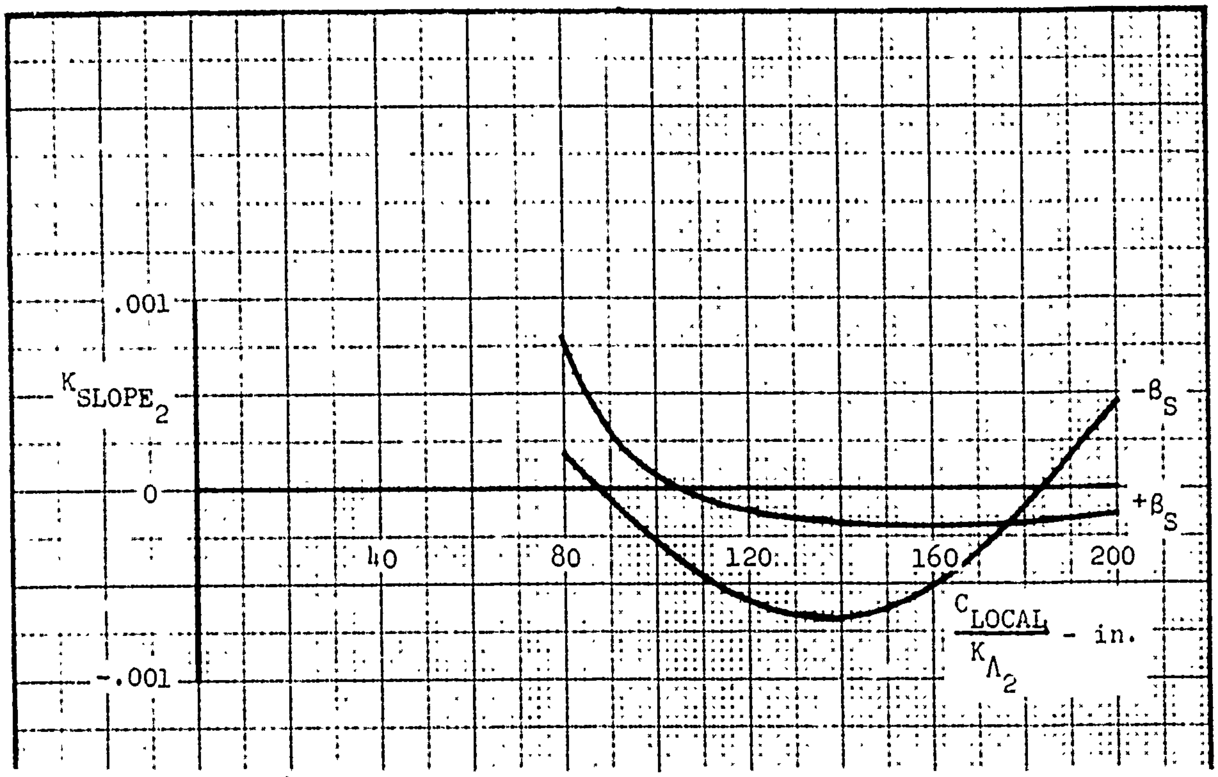

Figure 247. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE} for Mach Break 2

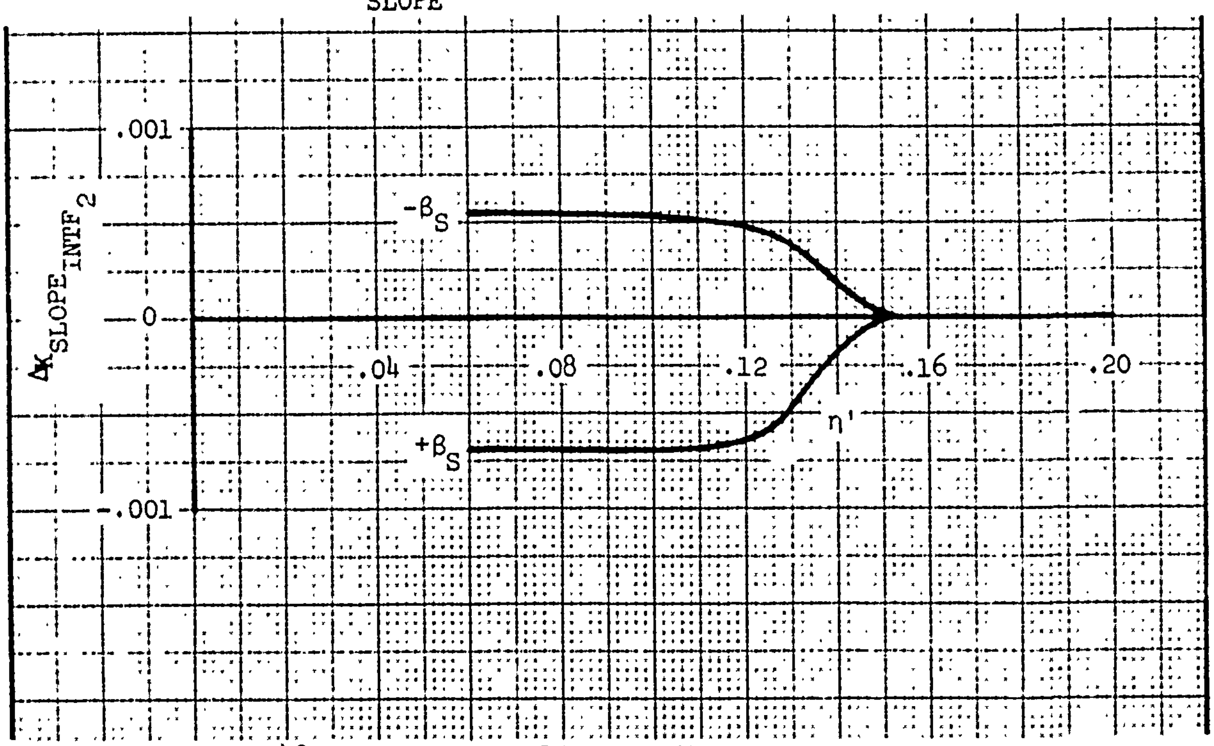

Figure 248. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE_2} Fuselage Interference Correction

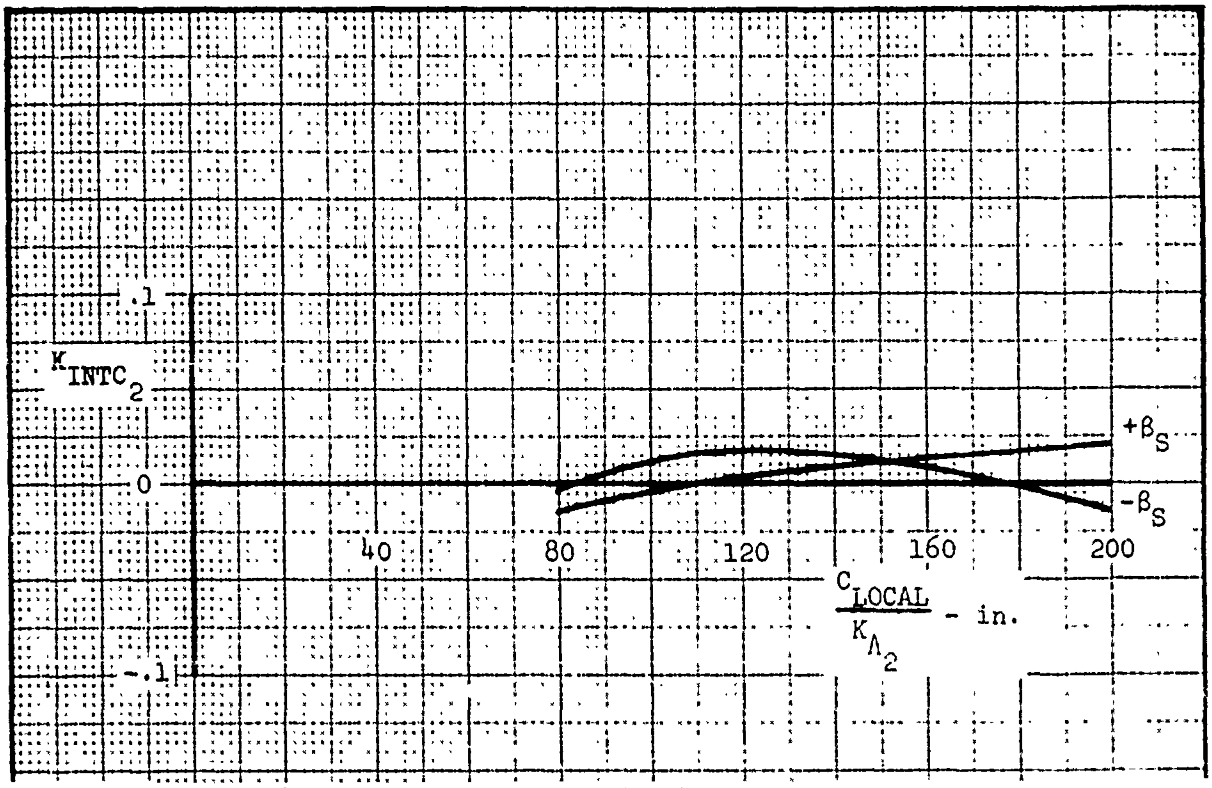

Figure 249. Incremental Pitching Moment Slope Due to Yaw - K_{INTC} for Mach Break 2

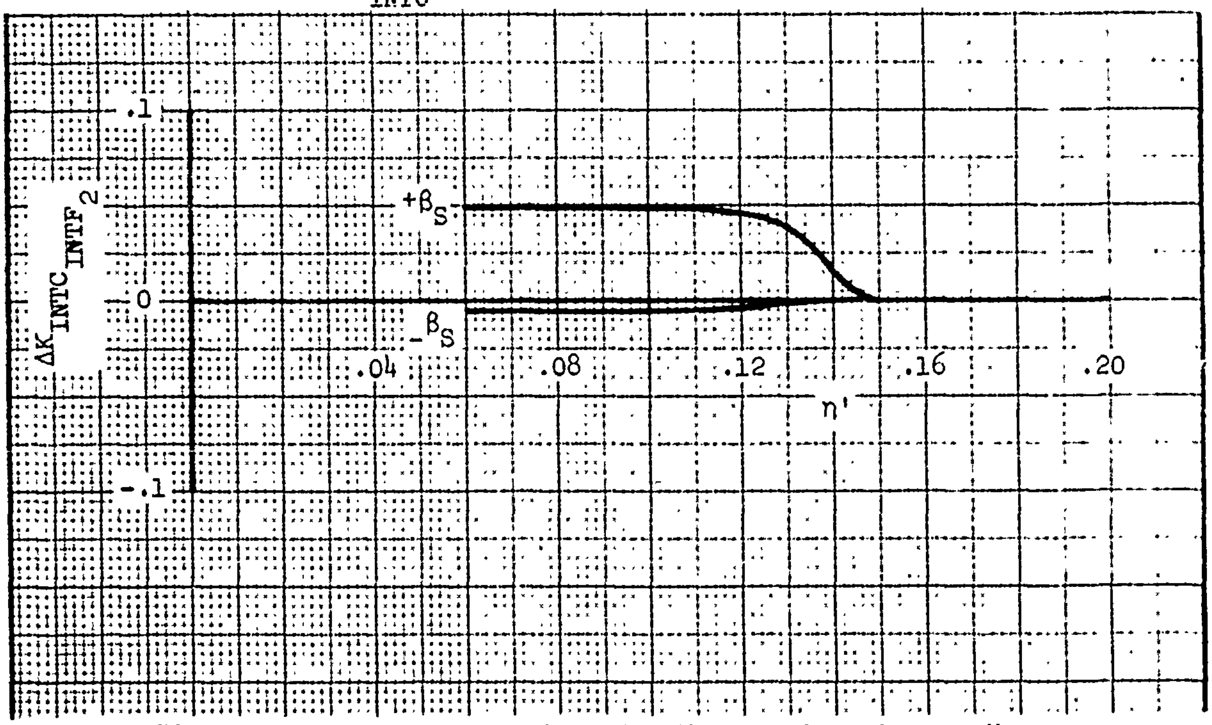

Figure 250. Incremental Pitching Moment Slope Due to Yaw - K_{INTC_2} Fuselage Interference Correction

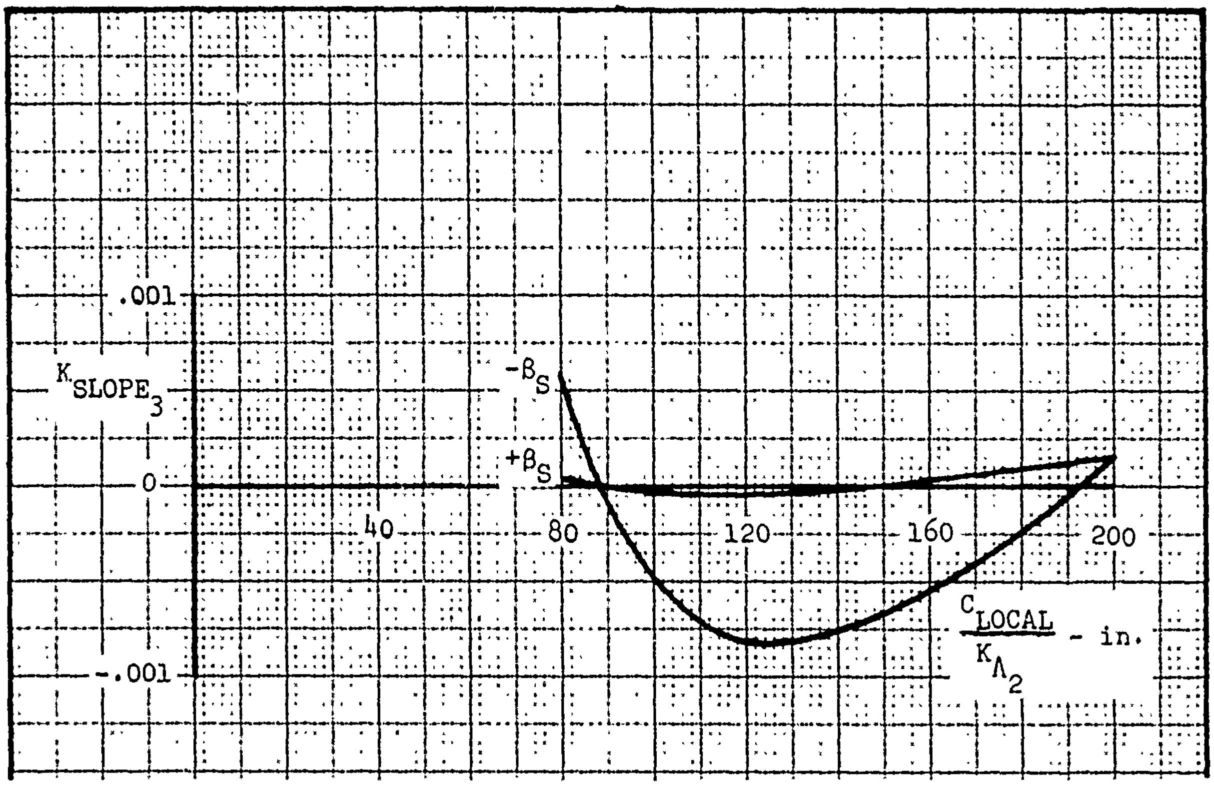

Figure 251. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE} for Mach Break 3

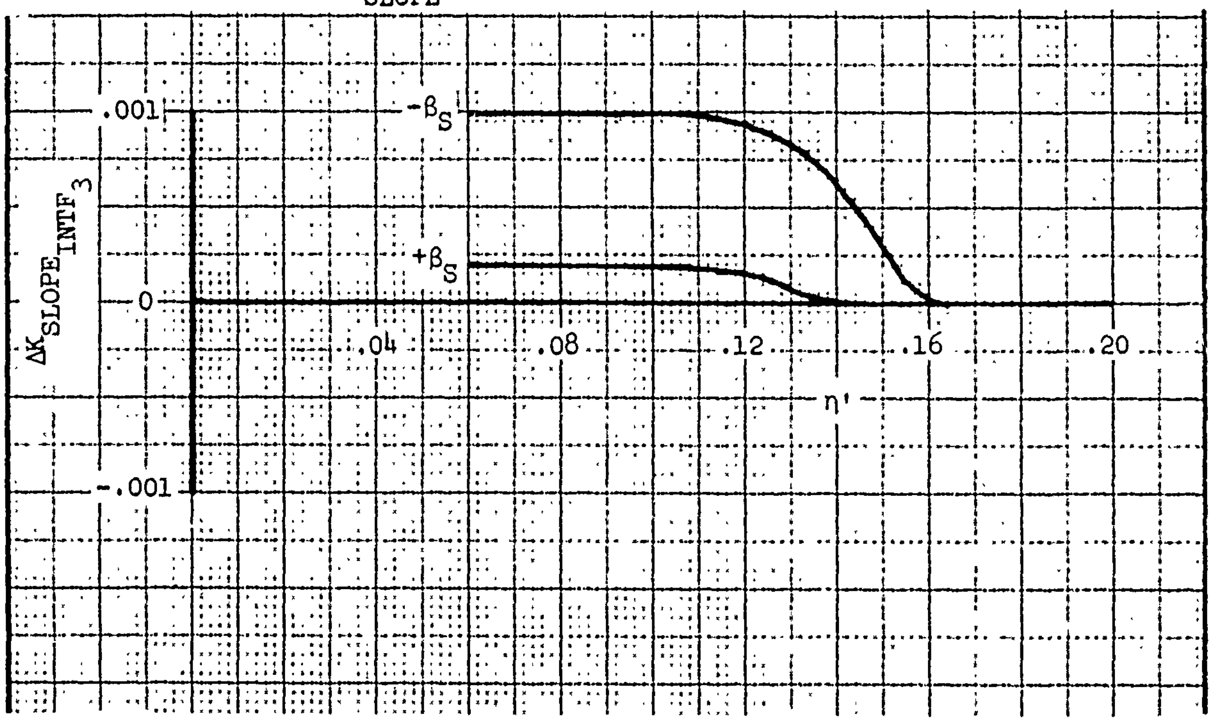

Figure 252. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE_3} Fuselage Interference Correction

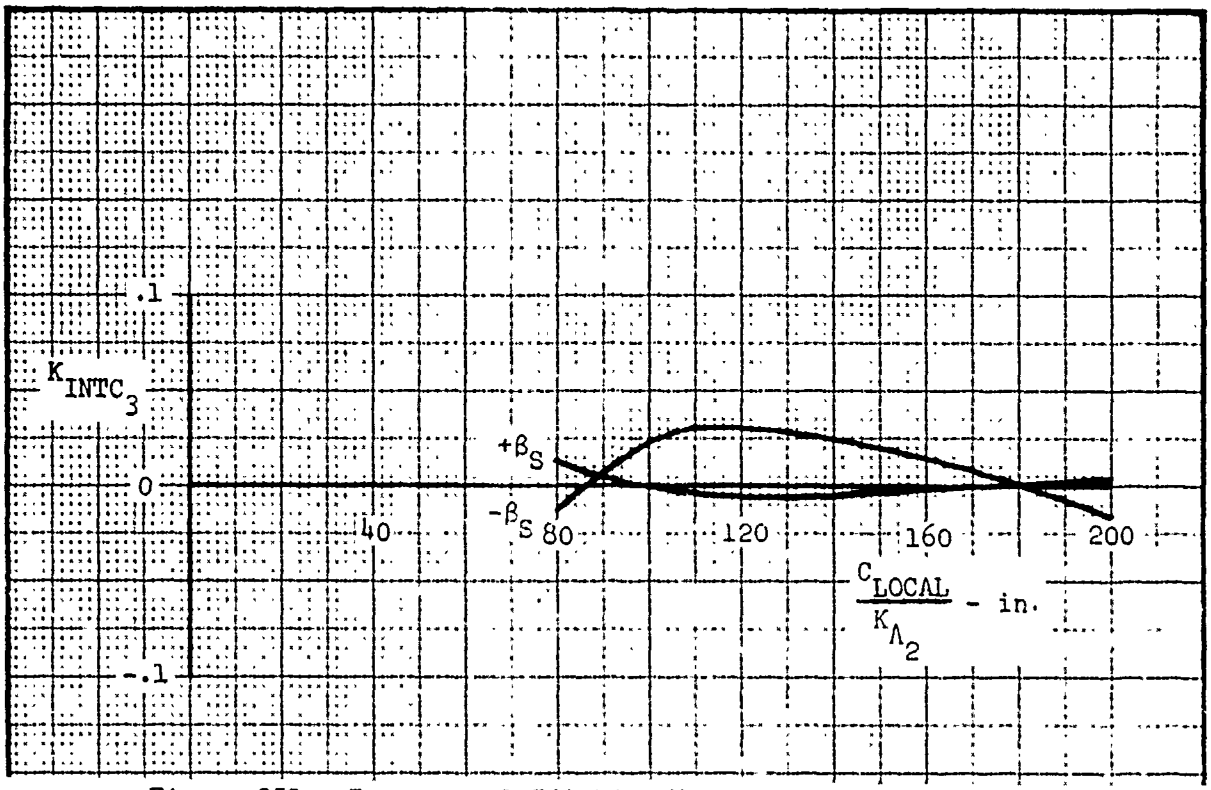

Figure 253. Incremental Pitching Moment Slope Due to Yaw - K_{INTC} for Mach Break 3

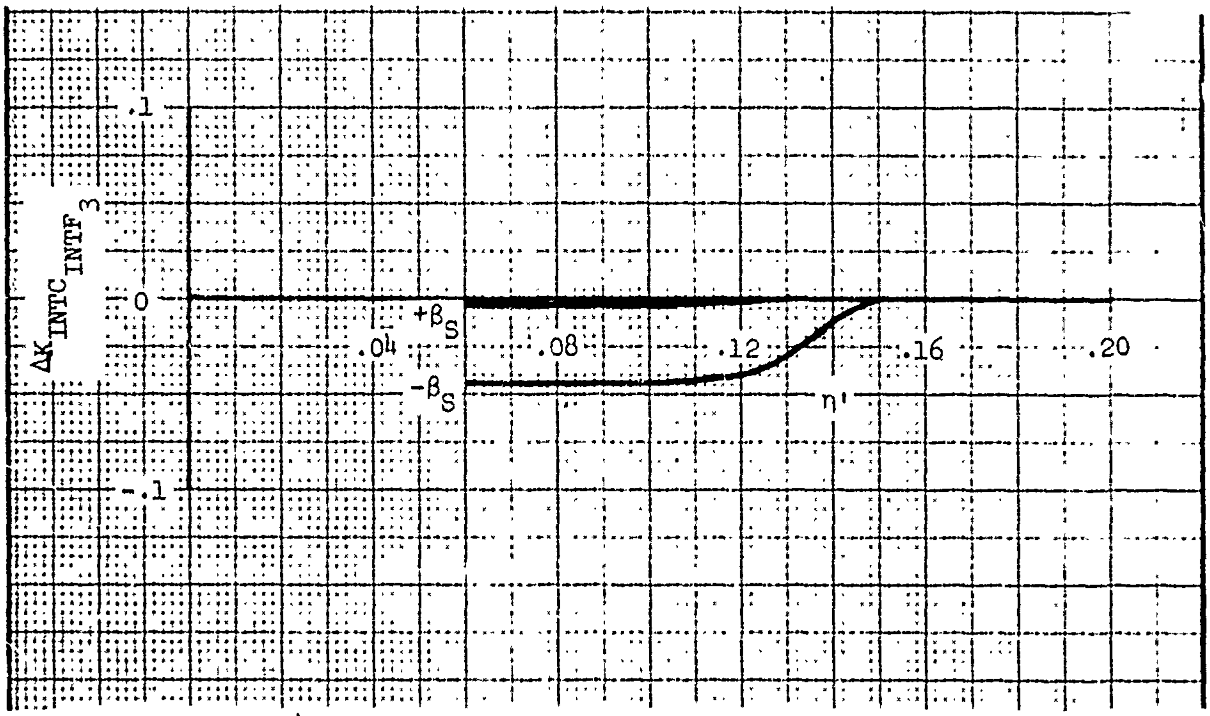

Figure 254. Incremental Pitching Moment Slope Due to Yaw - K_{INTC_3} Fuselage Interference Correction

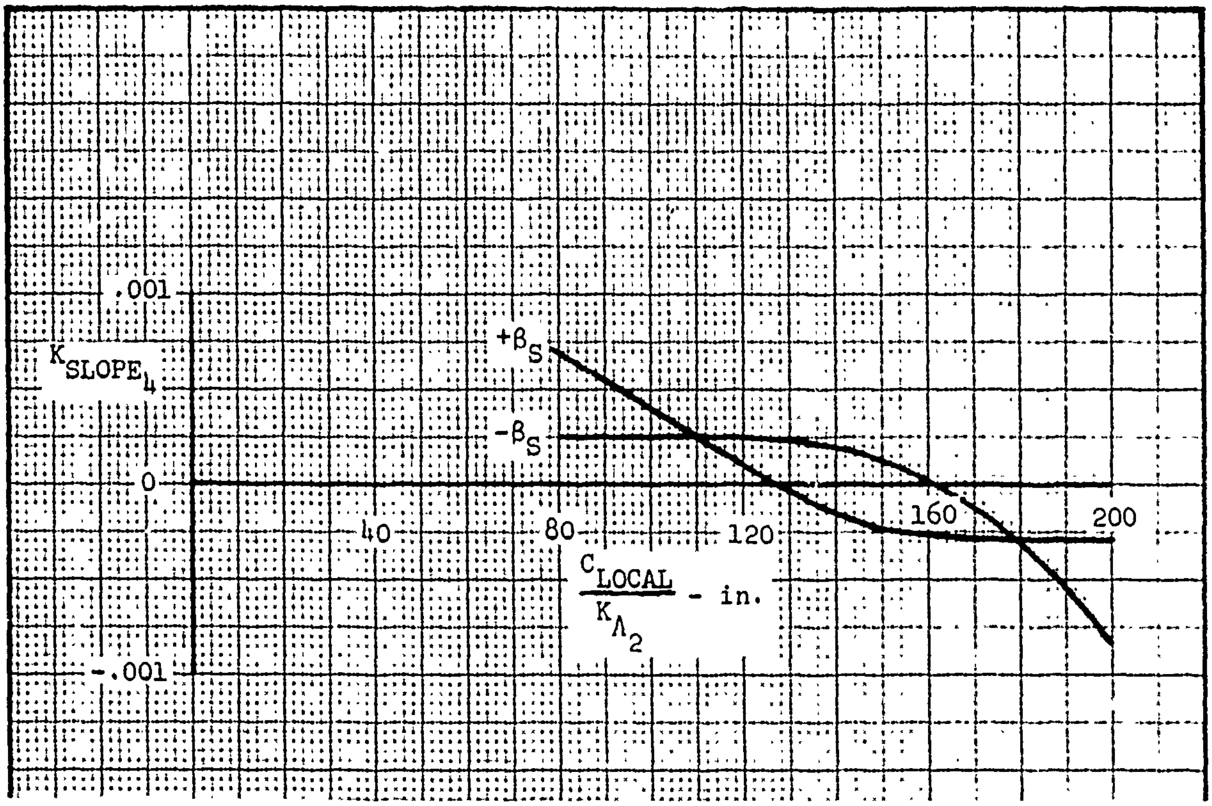

Figure 255. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE} for Mach Break 4

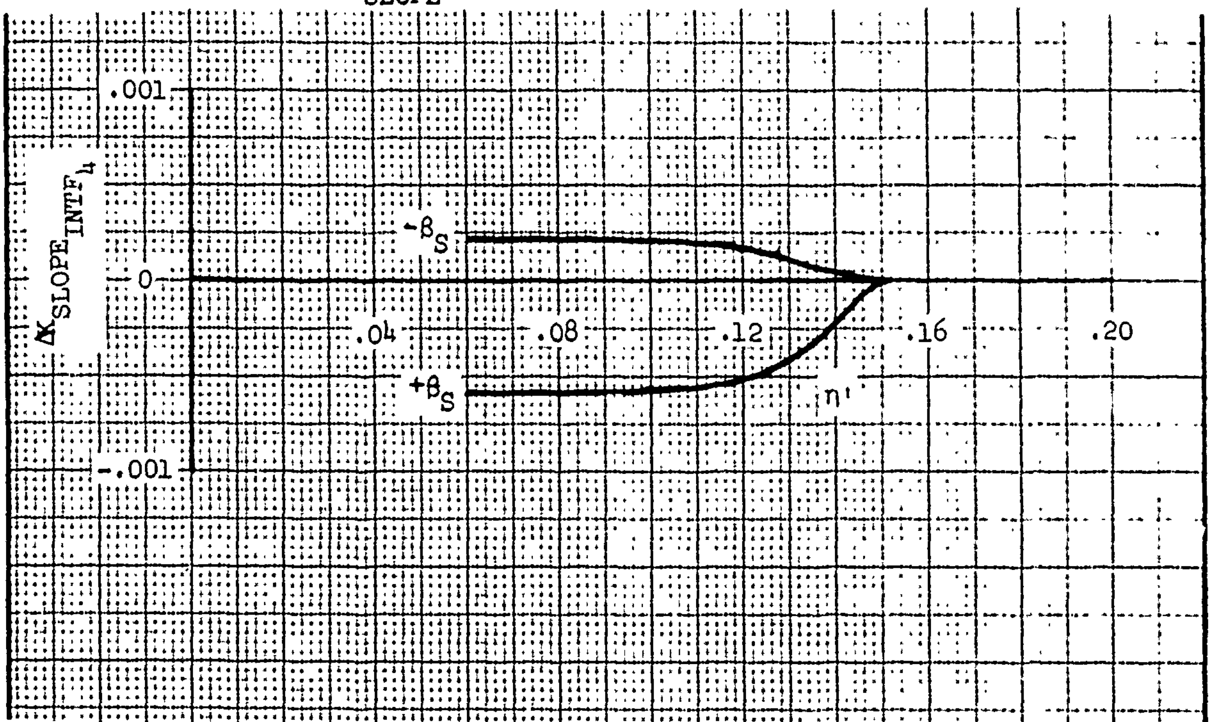

Figure 256. Incremental Pitching Moment Slope Due to Yaw - K_{SLOPE_4} Fuselage Interference Correction

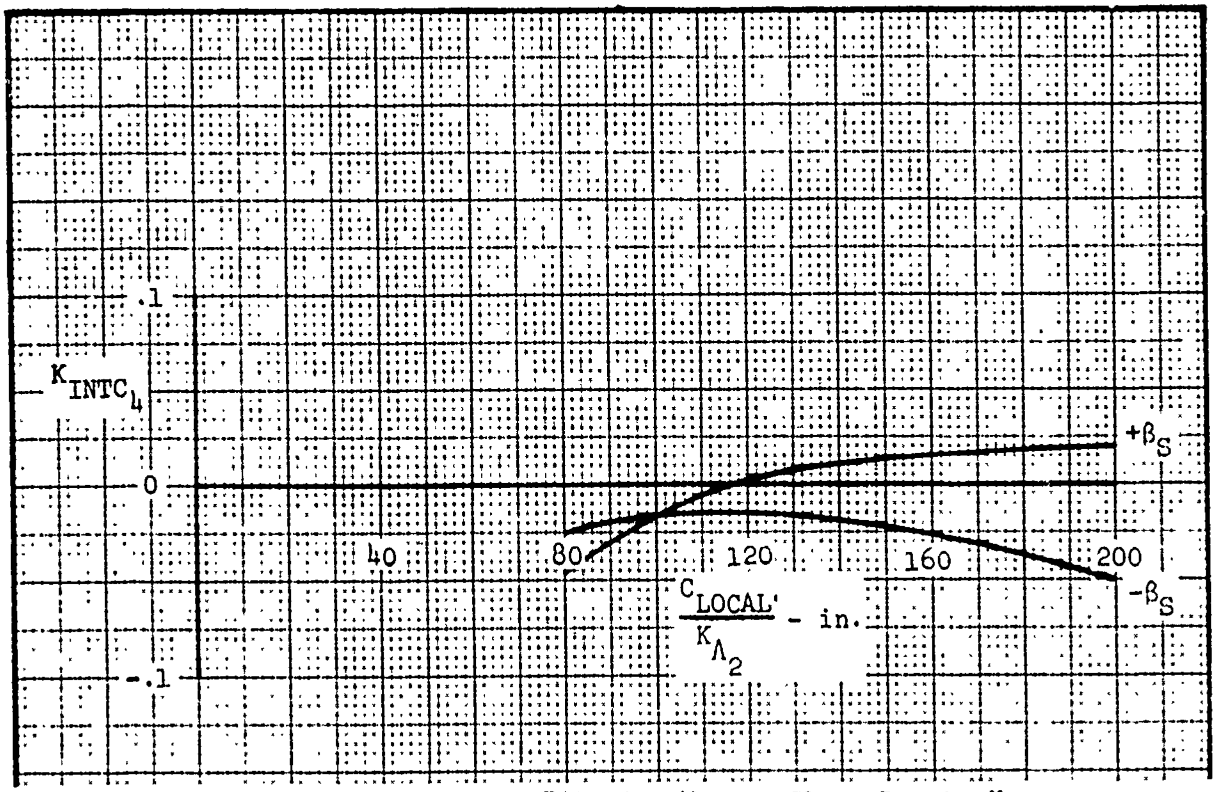

Figure 257. Incremental Pitching Moment Slope Due to Yaw - K_{INTC} for Mach Break 4

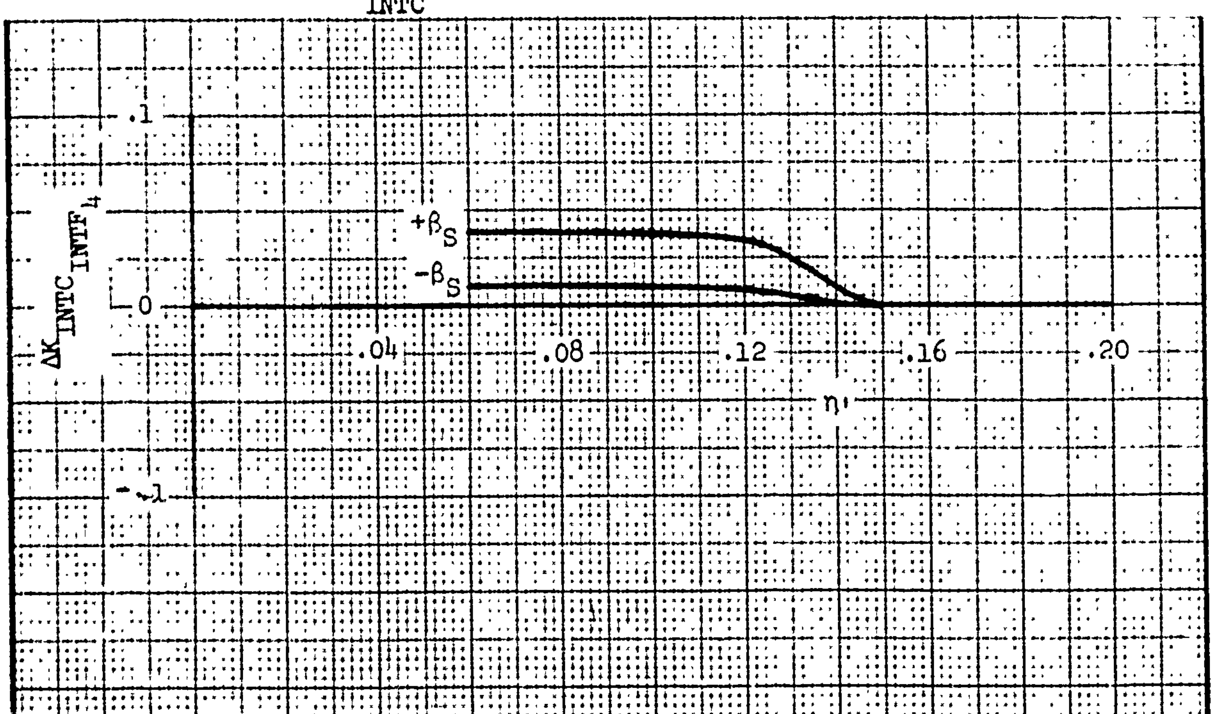

Figure 258. Incremental Pitching Moment Slope Due to Yaw - K_{INTC_4} Fuselage Interference Correction

3.4.2.3 Intercept Prediction

The value of incremental pitching moment intercept per degree β_S, $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$, for M = 0.5 is predicted by the following equation.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental $C_{m_{\alpha=0}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 259.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{in. - deg.}$, Figure 260.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.4.2.1.

K_{INTC_1} - Value of $\Delta C_{m_{\alpha=0_{\beta_S}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg.}$, Figure 261.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg.}$, Figure 262.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

A numerical example is presented in Subsection 3.4.2.1 which illustrates the use of the above equation.

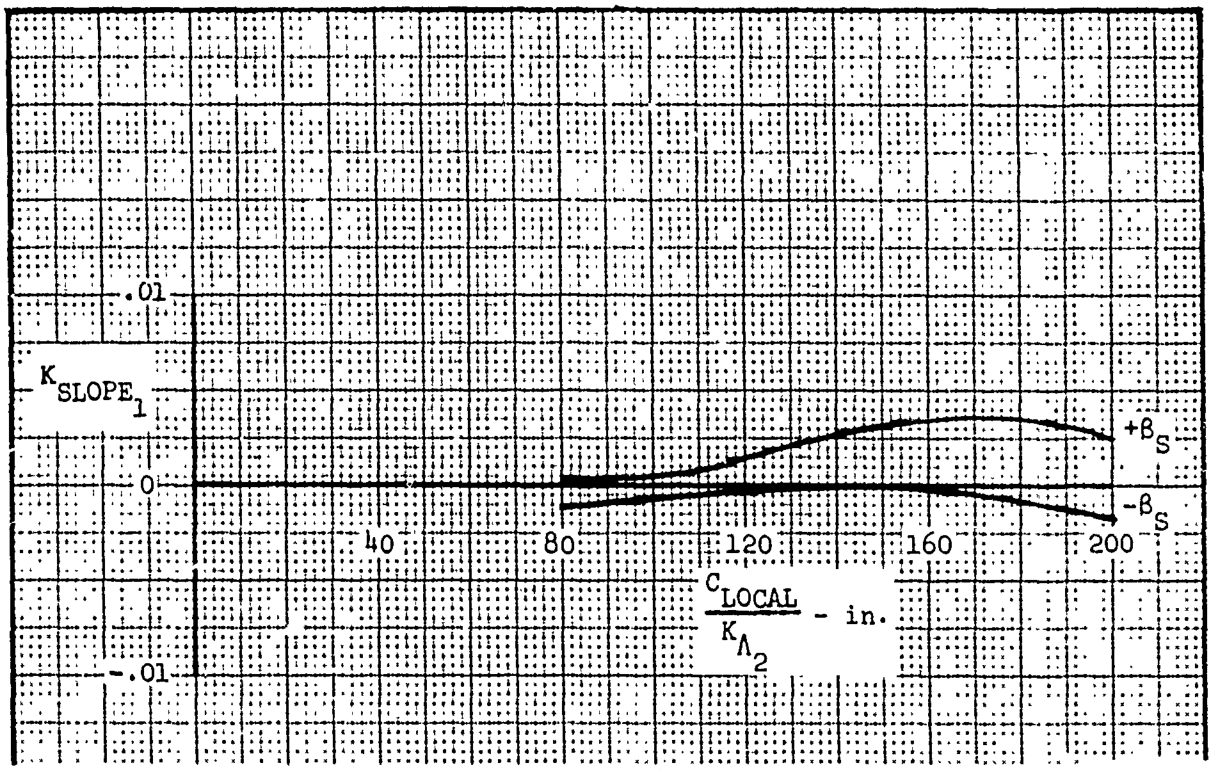

Figure 259. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

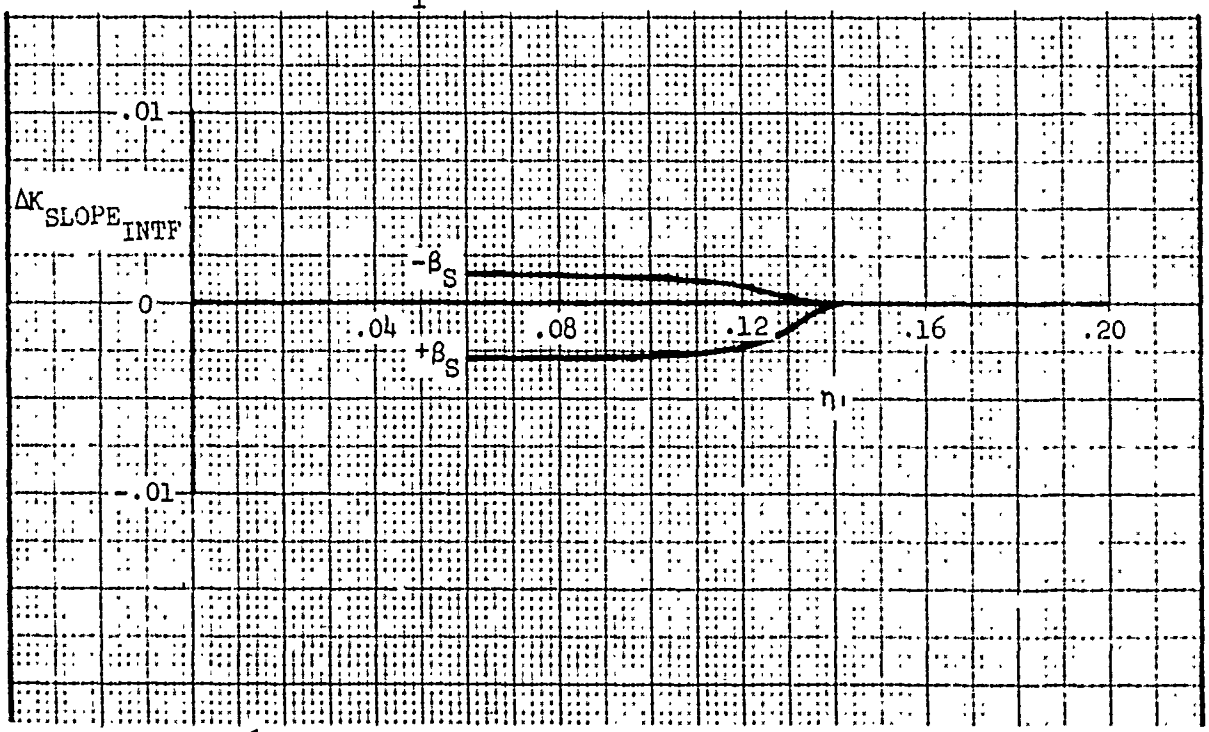

Figure 260. Incremental **Pitching** Moment Intercept Due to Yaw - K_{SLOPE_1} **Fuselage** Interference Correction

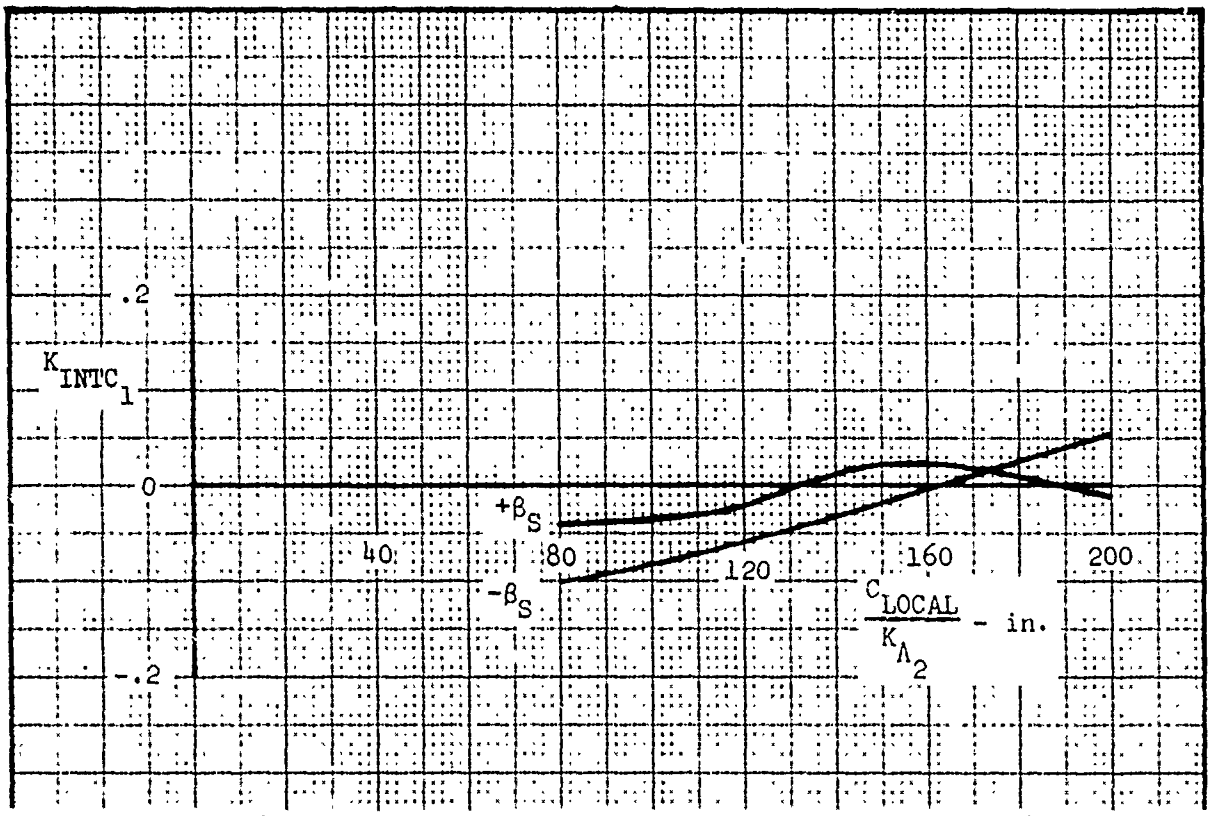

Figure 261. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC_1} for Positive and Negative Store Yaw

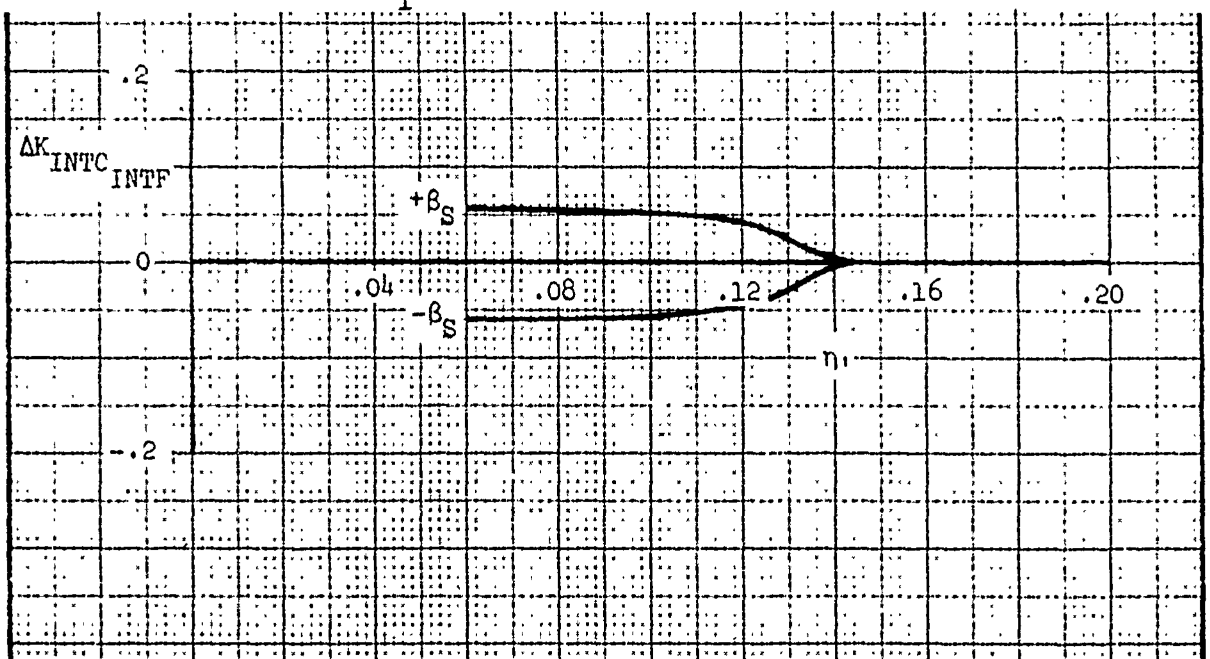

Figure 262. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

3.4.2.4 <u>Intercept Mach Number Correction</u>

The procedure for calculating the Mach number correction for incremental pitching moment intercept per degree β_S is the same as that presented in Subsection 3.2.2.2 for incremental yawing moment slope Mach number correction.

The incremental pitching moment intercept per degree β_S variation with Mach number has been fitted by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, M_3, and M_4 as in Figure 263.

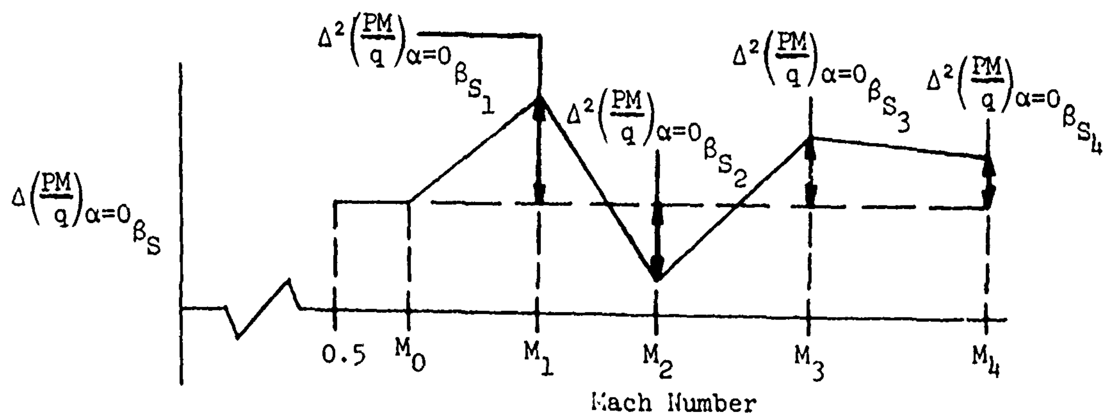

Figure 263. Incremental Pitching Moment Intercept Due to Yaw - Generalized Mach Number Variation

The variation of the Mach break points is presented in Figure 264 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is the Mach number where the incremental intercept initially deviates from the value predicted at M = 0.5. Equations to predict the incremental changes at the remaining Mach break points from the initial value at M = 0.5 are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_1}}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_{INTF_1}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_1} + \Delta K_{INTC_{INTF_1}}]S_{REF}d$$

where:

K_{SLOPE_1} - Variation of incremental $C_{m_{\alpha=0_1}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 265.

$\Delta K_{SLOPE_{INTF_1}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{in. - deg.}$, Figure 266.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.4.2.1.

K_{INTC_1} - Value of $\Delta C_{m_{\alpha=0_{\beta_{S_1}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg.}$, Figure 267.

$\Delta K_{INTC_{INTF_1}}$ - Incremental change in K_{INTC_1} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg.}$, Figure 268.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

d - Store diameter, ft.

Break 2 (M_2):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_2}}} = [(K_{SLOPE_2} + \Delta K_{SLOPE_{INTF_2}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2} + \Delta K_{INTC_{INTF_2}}]S_{REF}d$$

where:

K_{SLOPE_2} - Variation of incremental $C_{m_{\alpha=0_2}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 269.

$\Delta K_{SLOPE_{INTF_2}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{in. - deg.}$, Figure 270.

$\frac{ADJ.PPA}{L}$ - Defined in Section 3.4.2.1.

K_{INTC_2} - Value of $\Delta C_{m_{\alpha=0_{\beta_{S_2}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$, Figure 271.

$\Delta K_{INTC_{INTF_2}}$ - Incremental change in K_{INTC_2} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg.}$, Figure 272.

Break 3 (M_3):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_3}}} = [(K_{SLOPE_3} + \Delta K_{SLOPE_{INTF_3}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_3} + \Delta K_{INTC_{INTF_3}}]S_{REF}d$$

where:

K_{SLOPE_3} - Variation of incremental $C_{m_{\alpha=0_3}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 273.

$\Delta K_{SLOPE_{INTF_3}}$ - Incremental change in K_{SLOPE_3} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{\text{in. - deg.}}$, Figure 274.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.4.2.1.

K_{INTC_3} - Value of $\Delta C_{m_{\alpha=0}}{}_{\beta_{S_3}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{\text{deg}}$, Figure 275.

$\Delta K_{INTC_{INTF_3}}$ - Incremental change in K_{INTC_3} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{\text{deg}}$, Figure 276.

Break 4 (M_4):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_4}}} = [(K_{SLOPE_4} + \Delta K_{SLOPE_{INTF_4}})\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4} + \Delta K_{INTC_{INTF_4}}]S_{REF}d$$

where:

K_{SLOPE_4} - Variation of incremental $C_{m_{\alpha=0_4}}$ per degree β_S with $\frac{ADJ.PPA}{L}$, $\frac{1}{\text{in. - deg.}}$, Figure 277.

$\Delta K_{SLOPE_{INTF_4}}$ - Incremental change in K_{SLOPE_4} due to interference effect of the fuselage for a high wing aircraft, $\frac{1}{\text{in. - deg.}}$, Figure 278.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.4.2.1.

K_{INTC_4} - Value of $\Delta C_{m_{\alpha=0_{\beta_{S_4}}}}$ when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg}$ Figure 279.

$\Delta K_{INTC_{INTF_4}}$ - Incremental change in K_{INTC_4} due to interference effect of the fuselage for high wing aircraft, $\frac{1}{deg}$, Figure 280.

To compute $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = x, first determine from Figure 264 between which Mach break points M = x occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Compute $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = x from the following expression.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_{M=x}}}} = \Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_{M=.5}}}} + \Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_{M_{LOW}}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right) \left[\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_{M_{HI}}}}} - \Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_{S_{M_{LOW}}}}} \right]$$

If $x < M_0$, then $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = x is equal to the value of $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = 0.5 (the initial term of the above equation from Subsection 3.4.2.3).

If x > M = 1.6 then, $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = x is equal to the value of $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{\beta_S}}$ at M = 1.6.

A numerical example of the above equation is contained in Subsection 3.2.2.2.

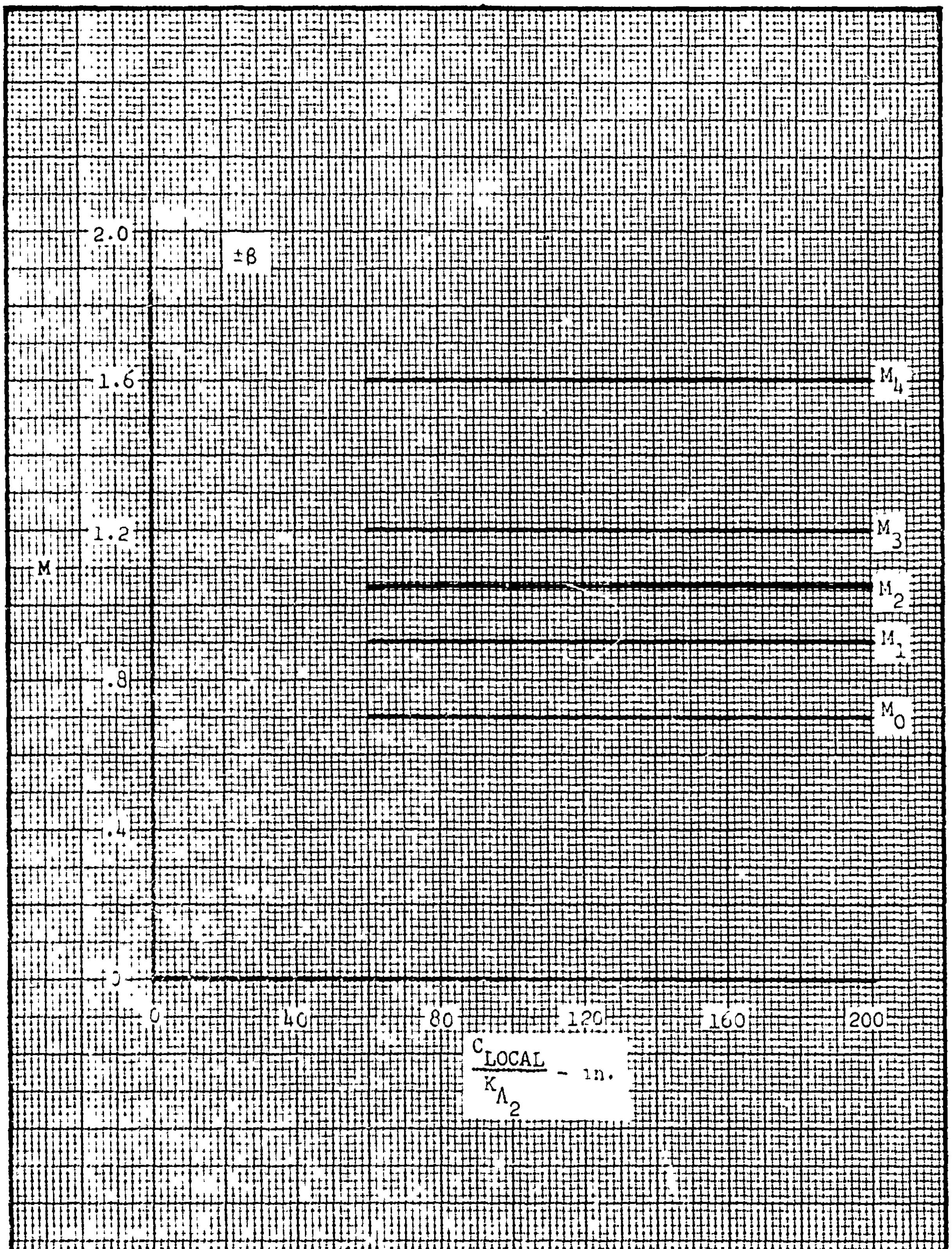

Figure 26? Incremental Pitching Moment Intercept Due to Yaw - Mach Number Break Points for Positive and Negative Store Yaw

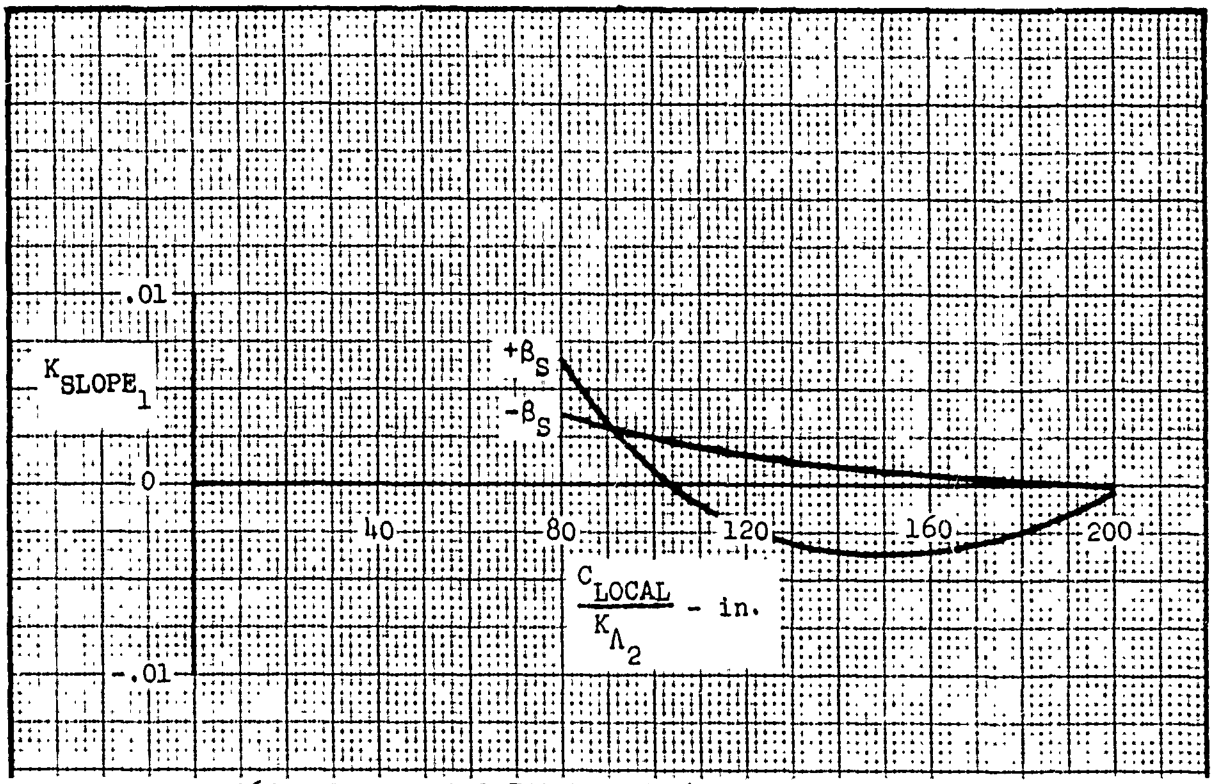

Figure 265. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE} for Mach Break 1

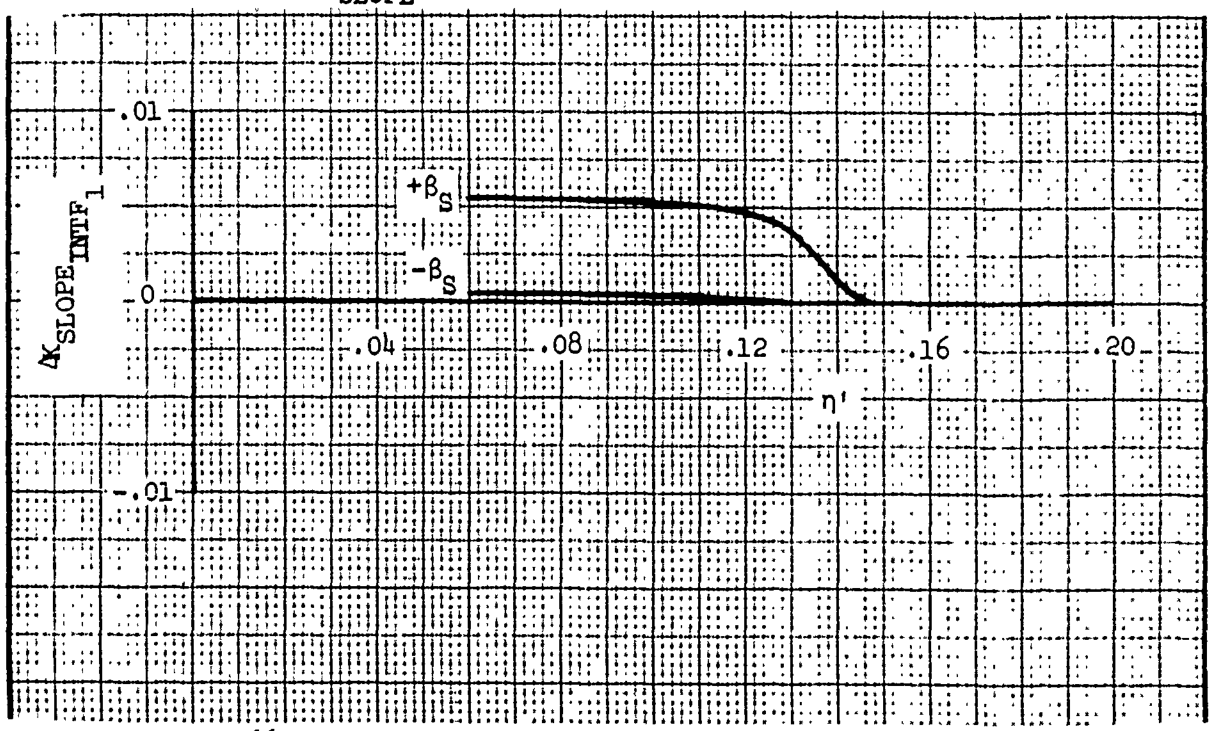

Figure 266. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

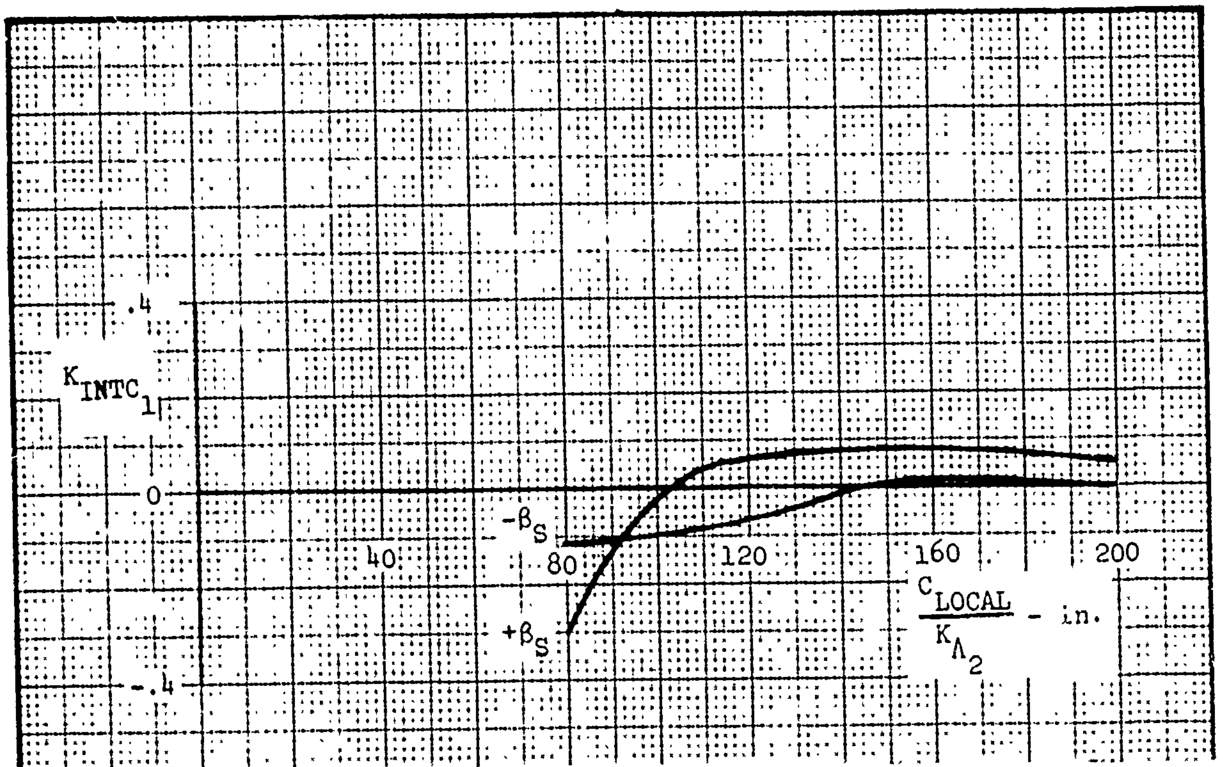

Figure 267. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC} for Mach Break 1

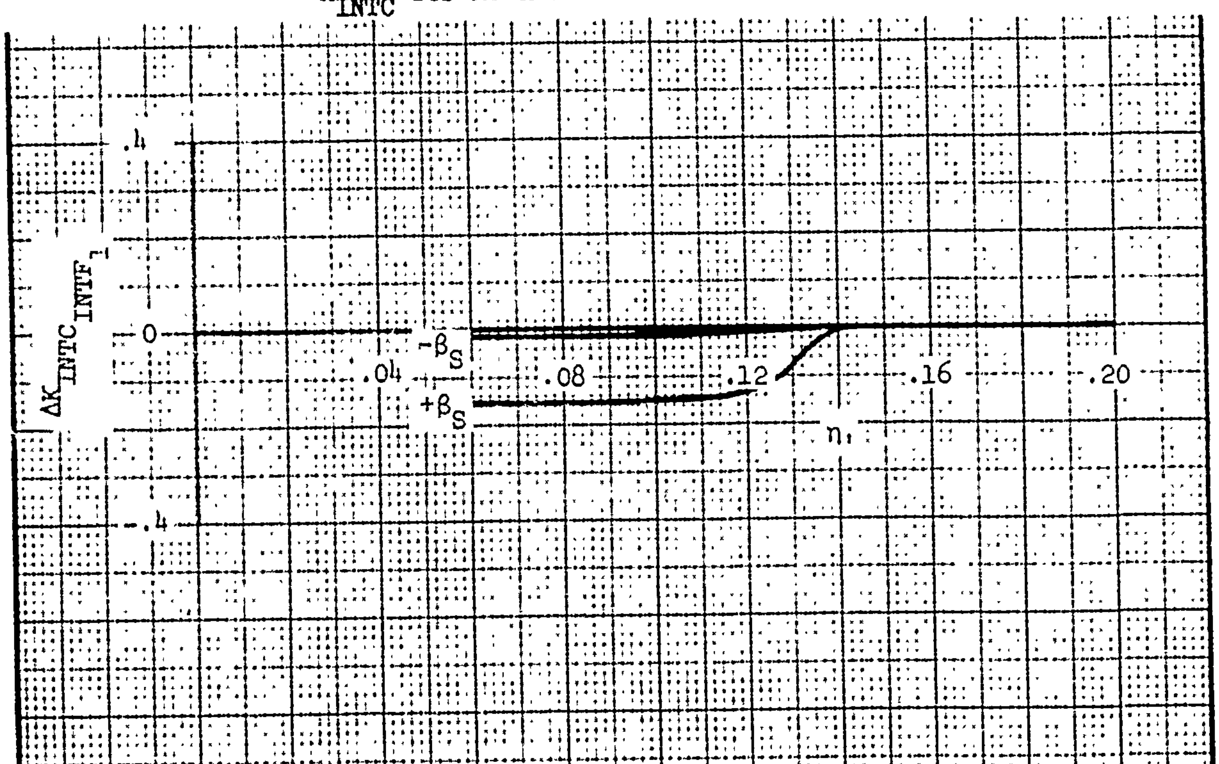

Figure 268. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC_1} Fuselage Interference Correction

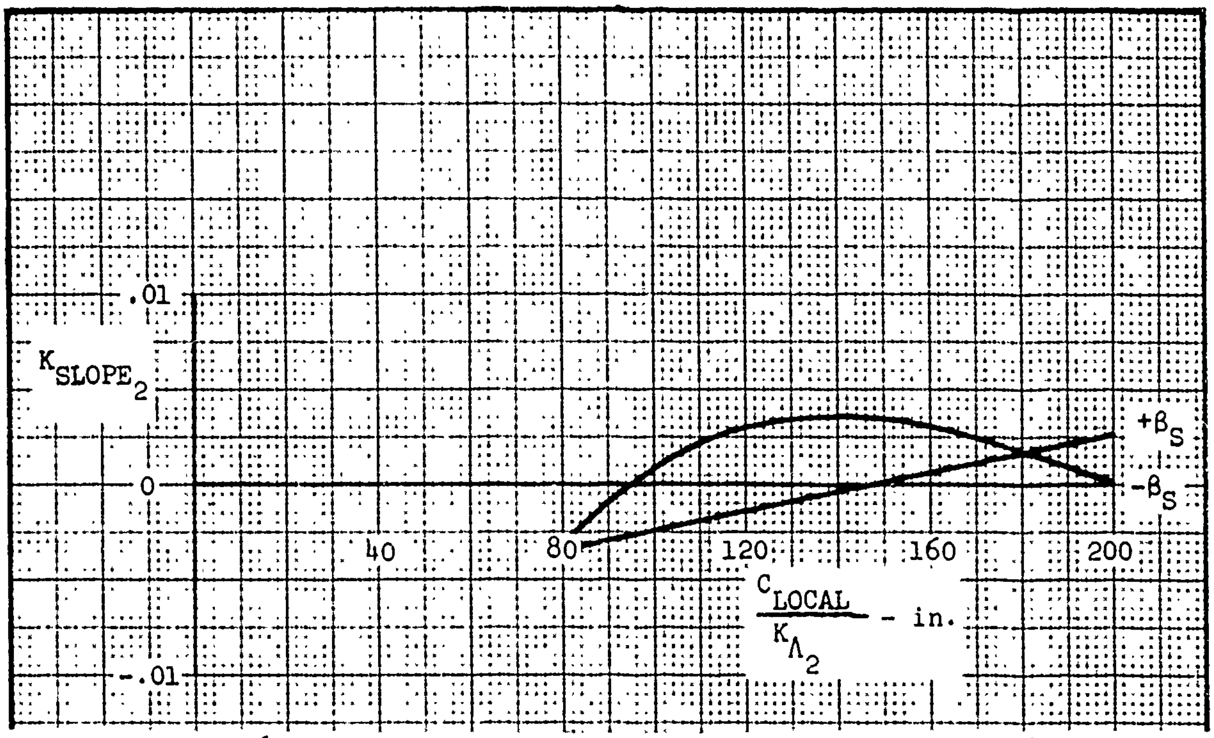

Figure 269. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE} for Mach Break 2

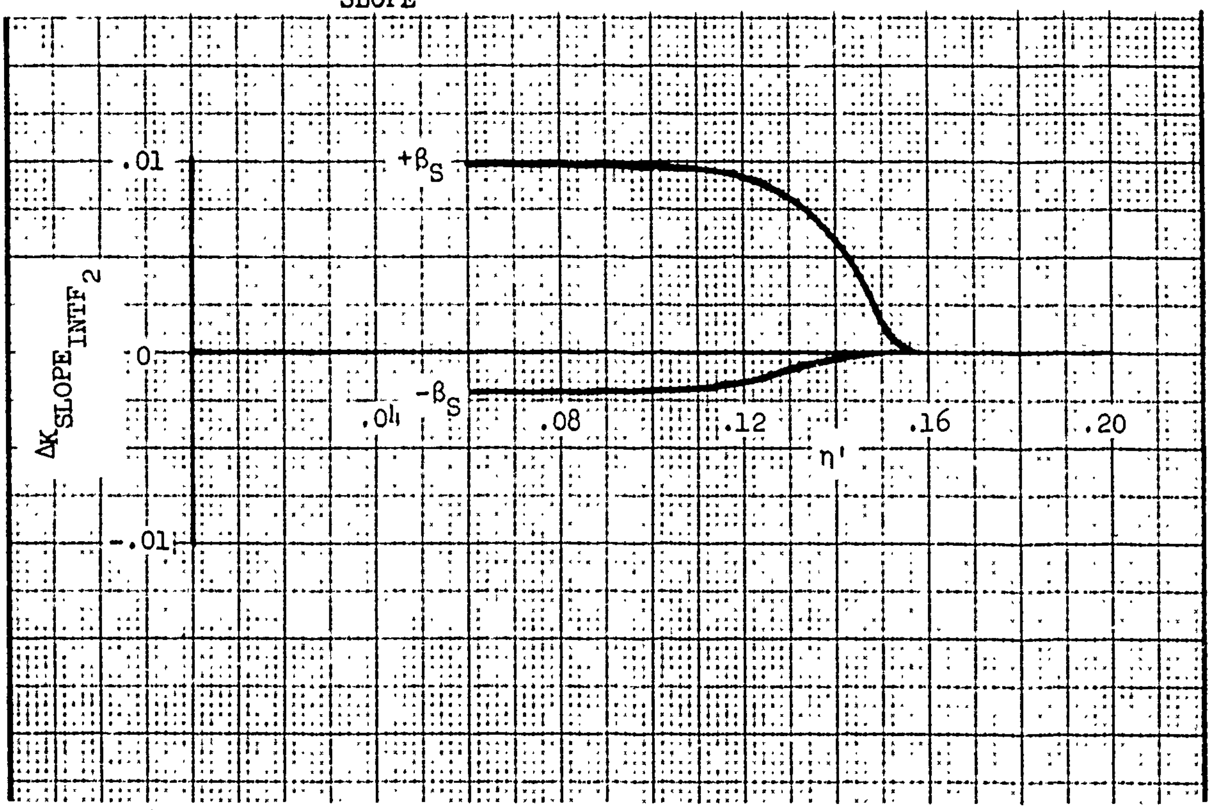

Figure 270. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE_2} Fuselage Interference Correction

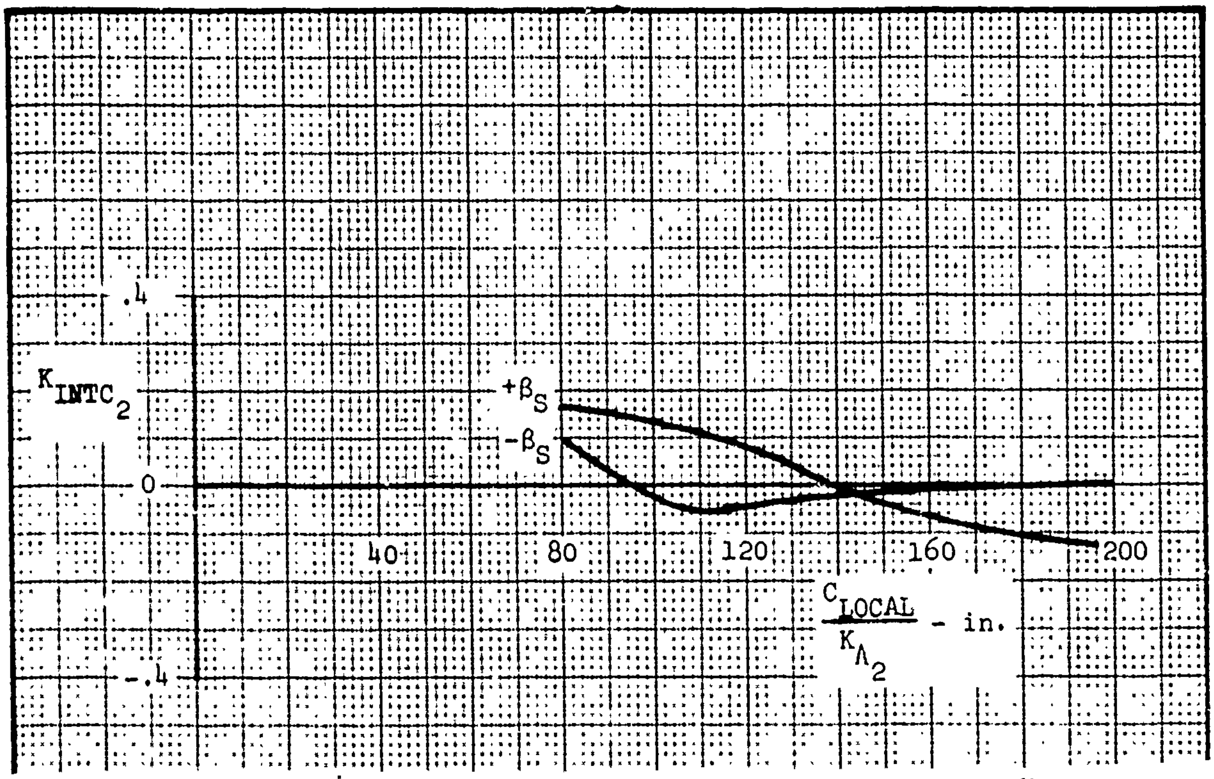

Figure 271. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC} for Mach Break 2

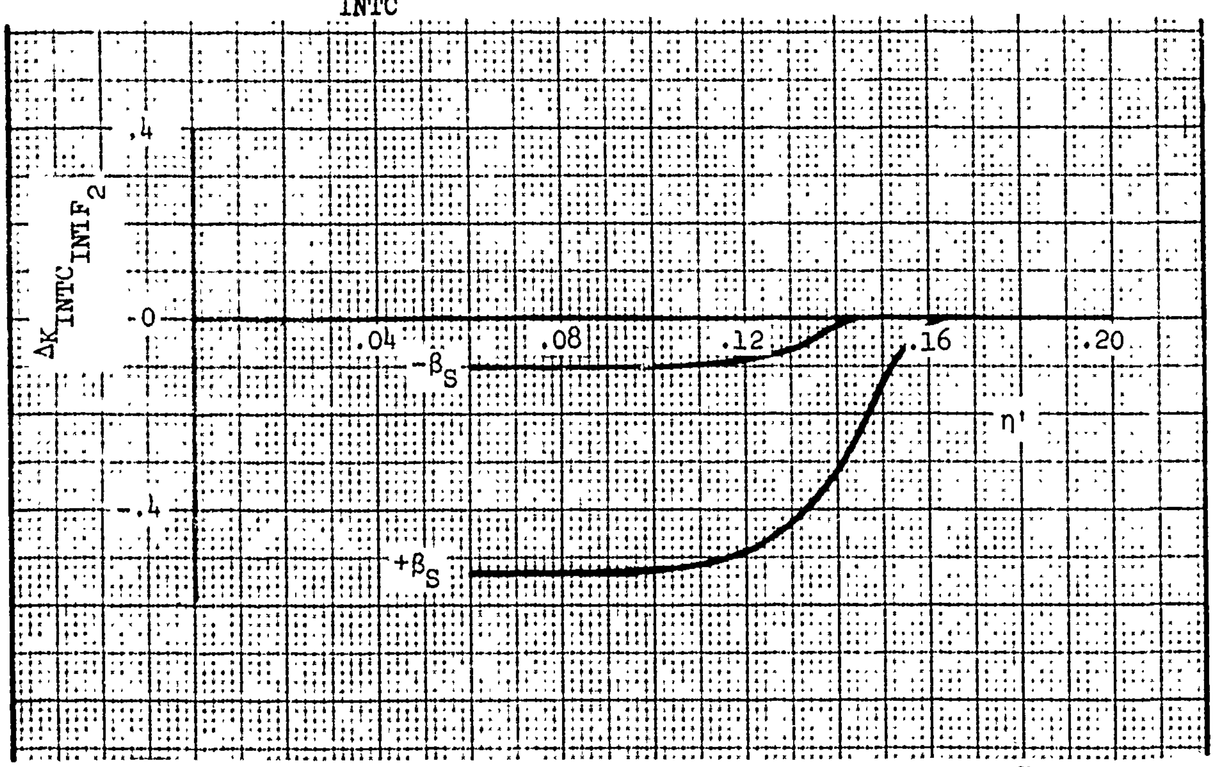

Figure 272. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC_2} Fuselage Interference Correction

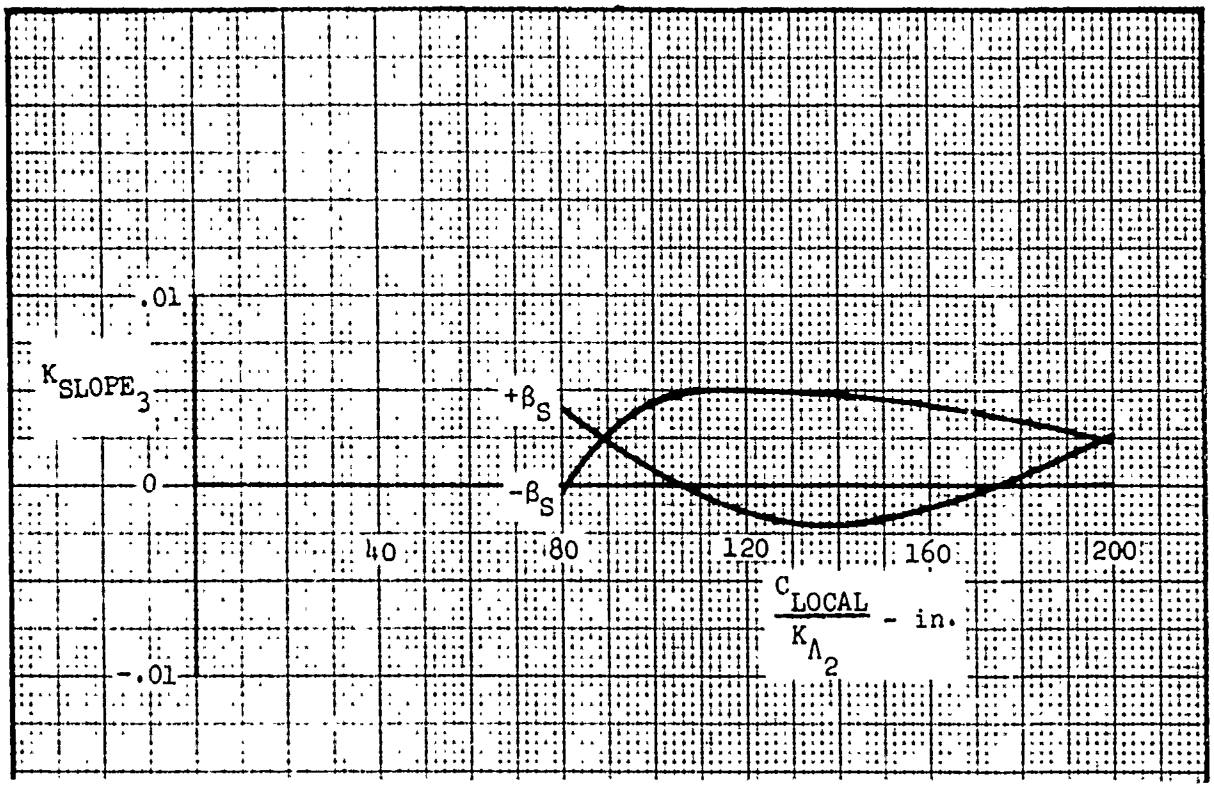

Figure 273. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE} for Mach Break 3

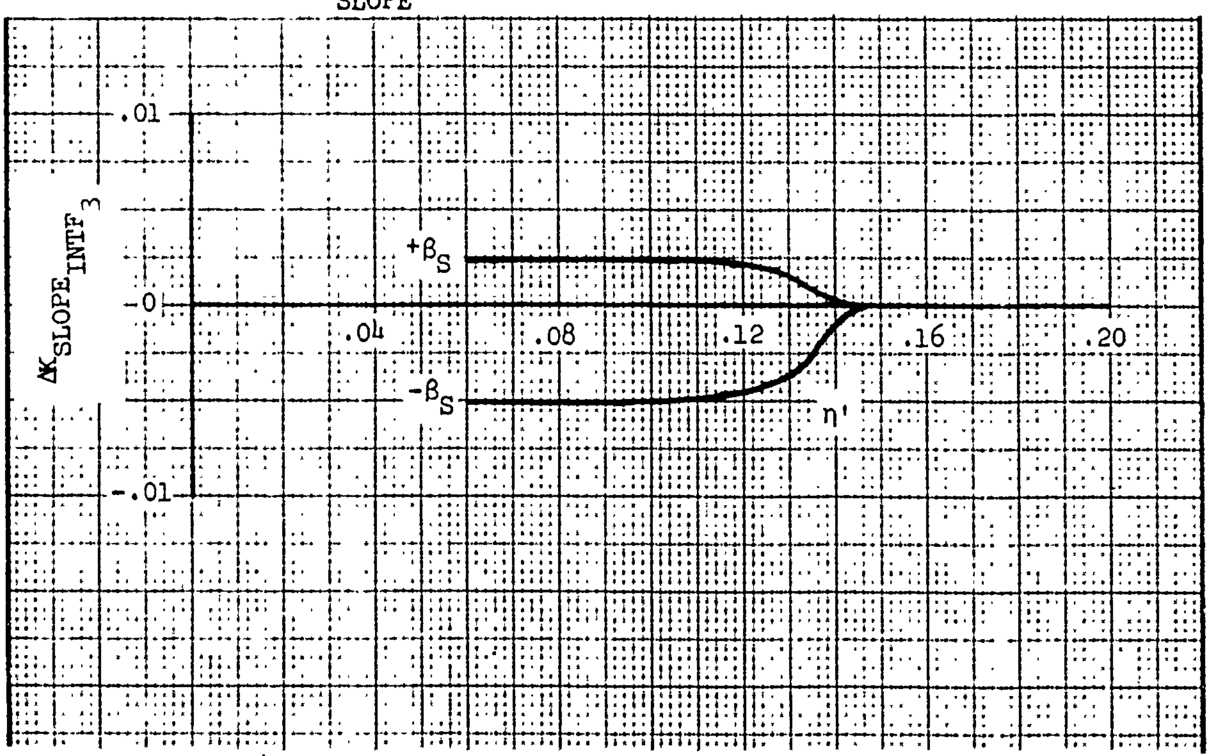

Figure 274. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE_3} Fuselage Interference Correction

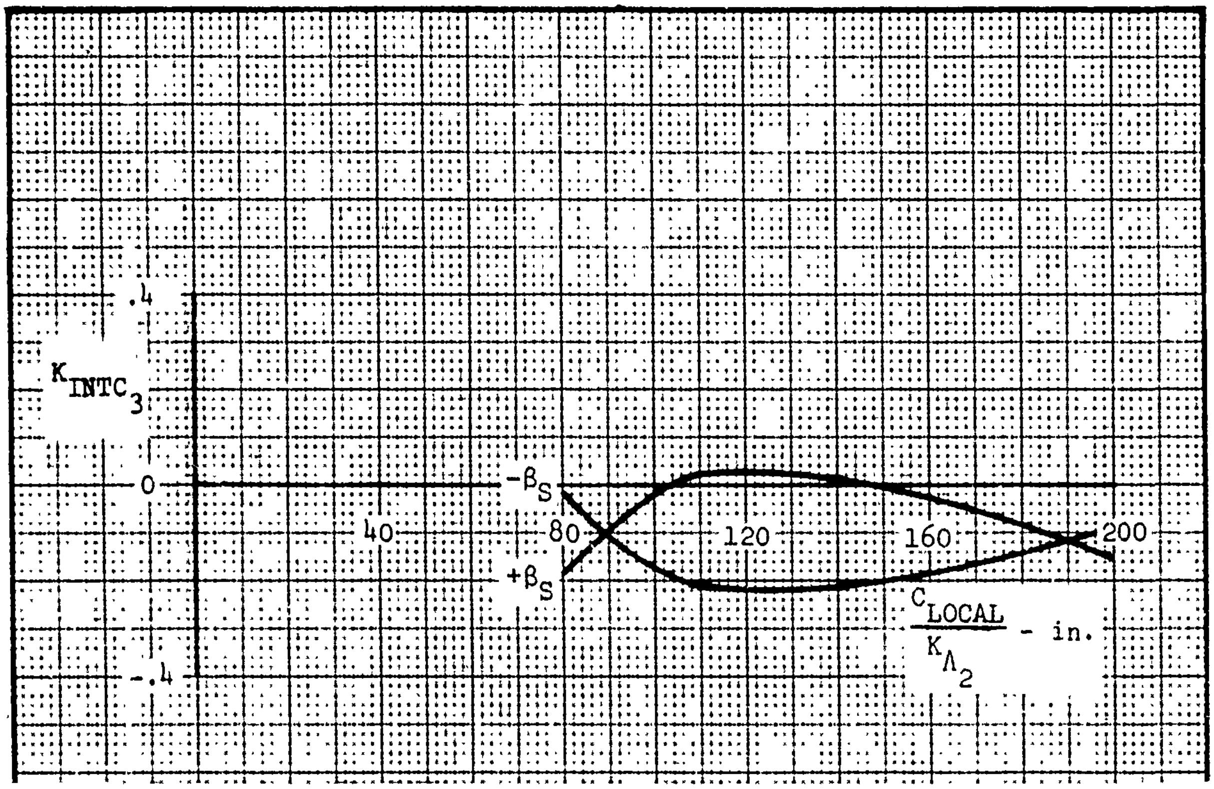

Figure 275. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC} for Mach Break 3

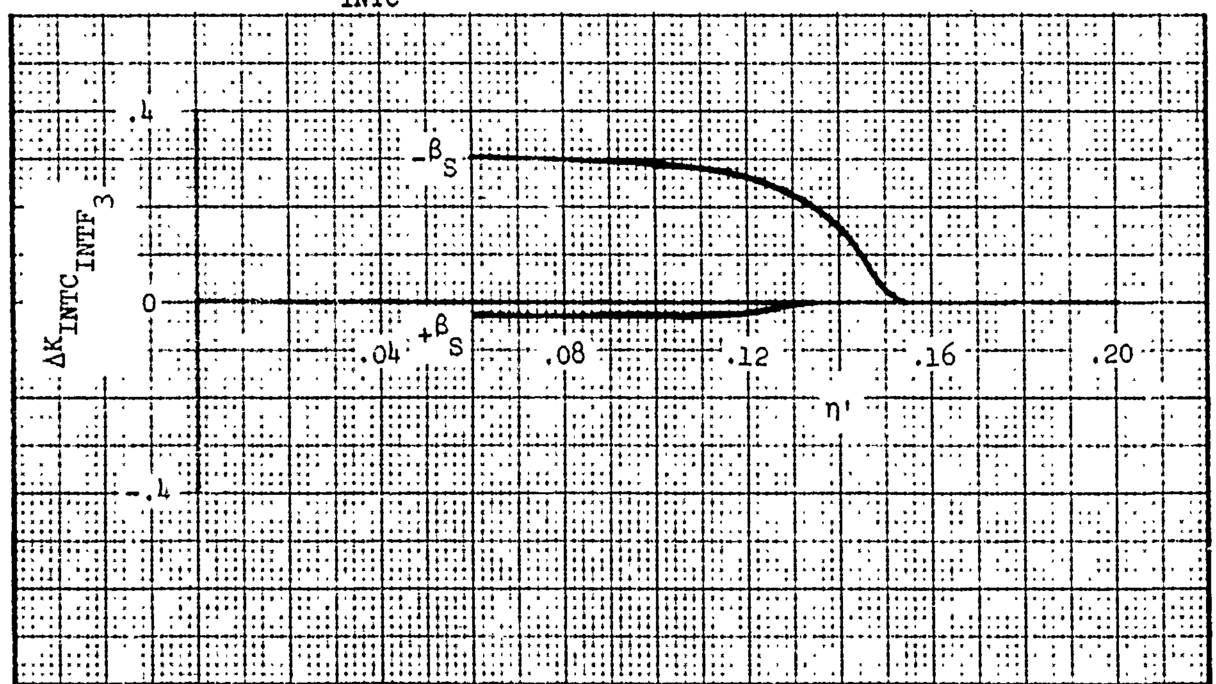

Figure 276. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC_3} Fuselage Interference Correction

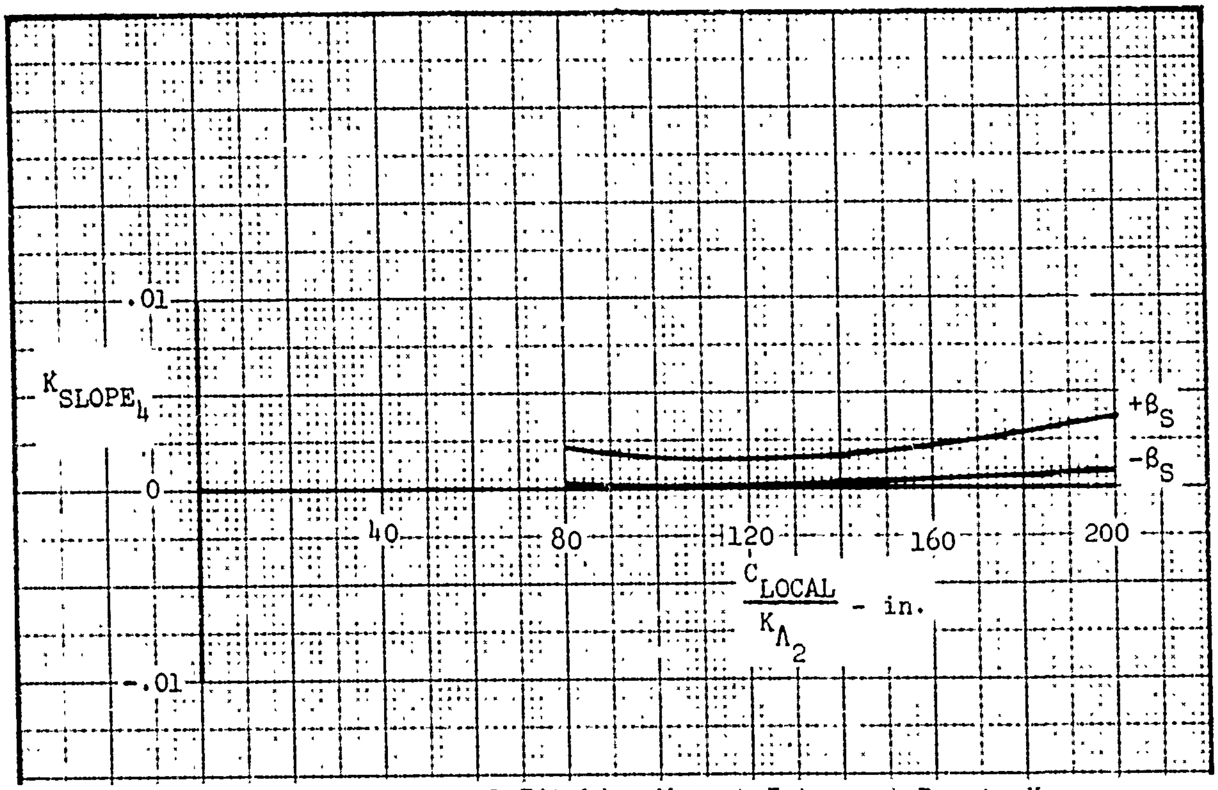

Figure 277. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE} for Mach Break 4

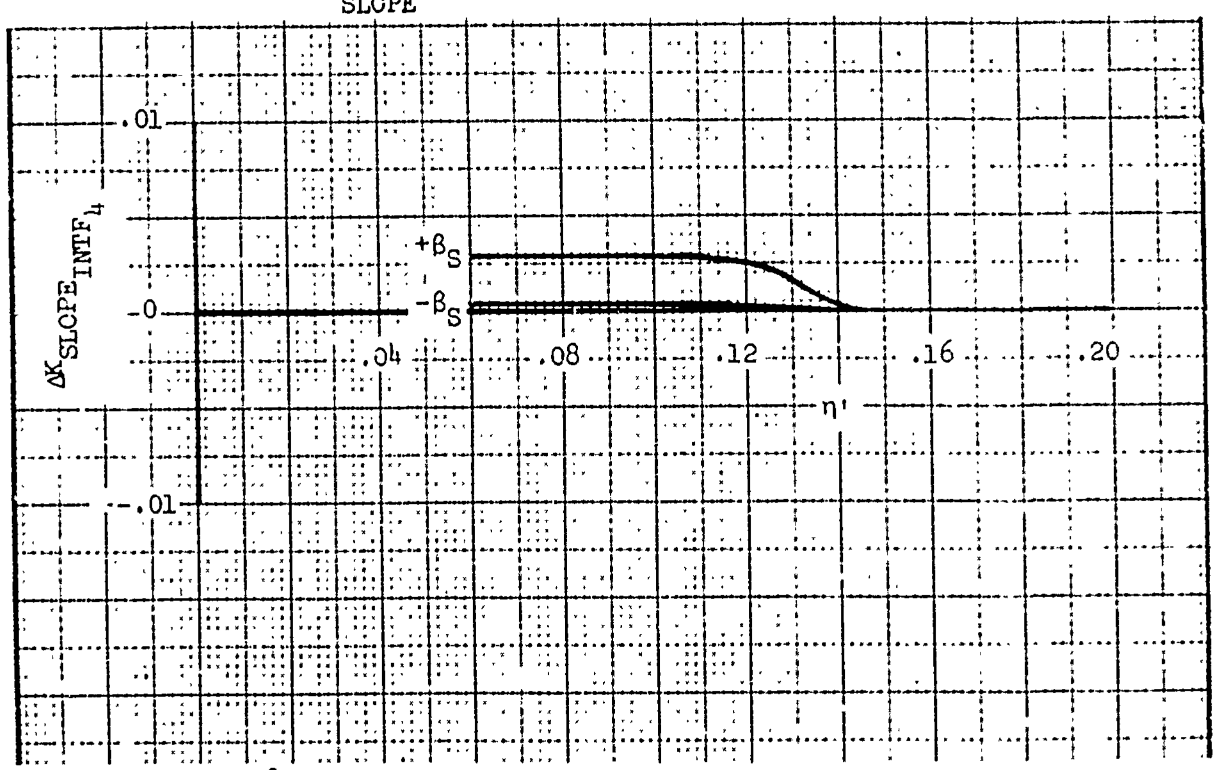

Figure 278. Incremental Pitching Moment Intercept Due to Yaw - K_{SLOPE_4} Fuselage Interference Correction

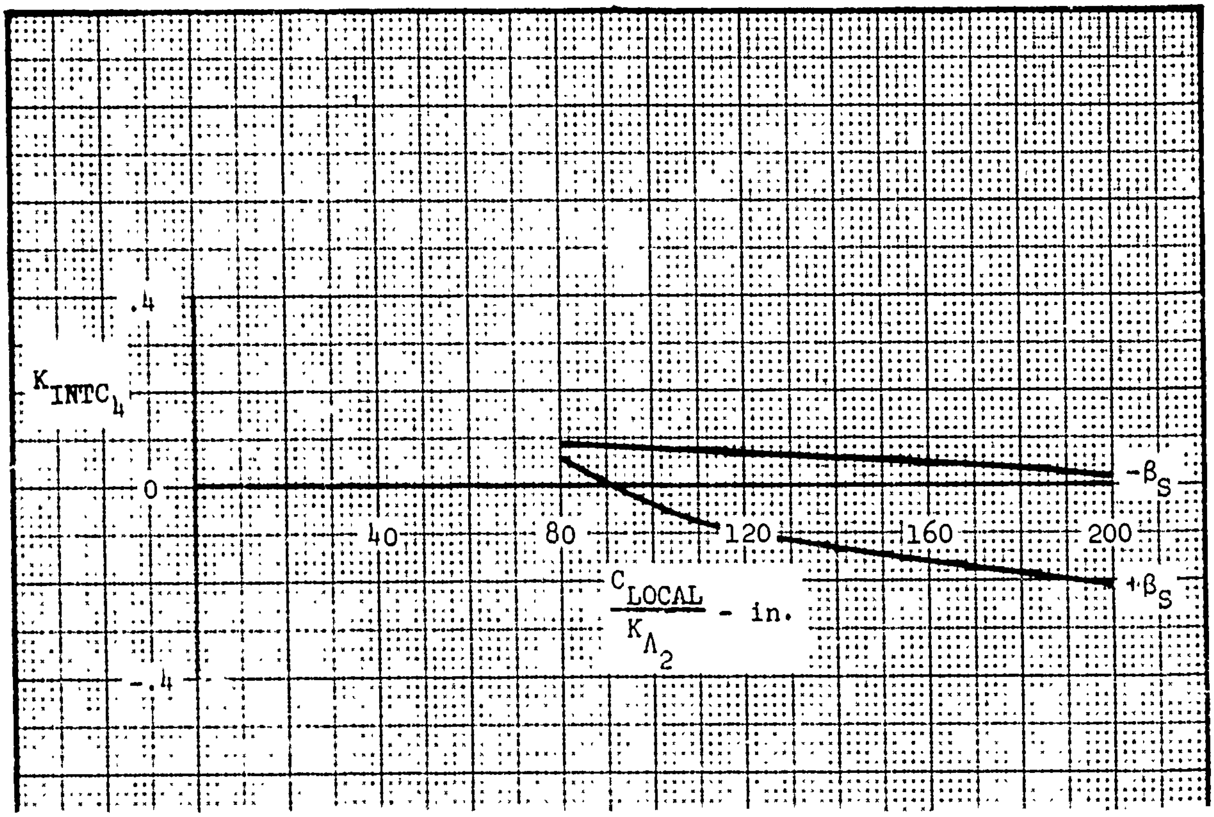

Figure 279. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC} for Mach Break 4

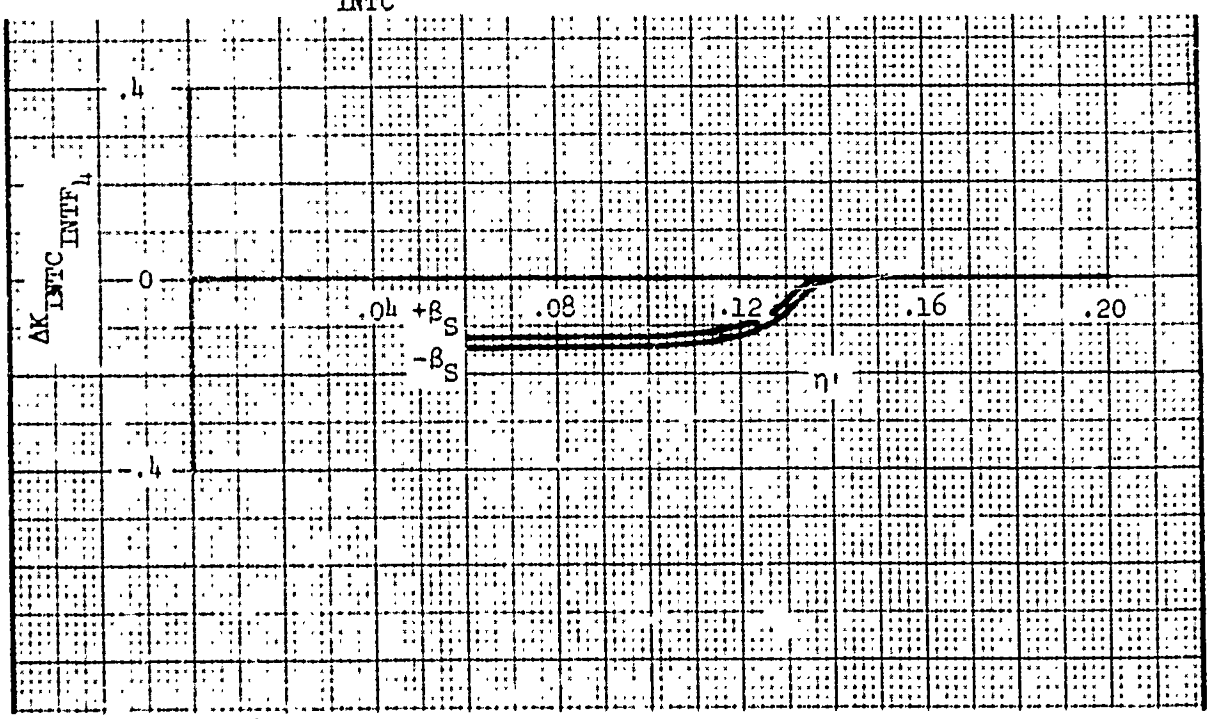

Figure 280. Incremental Pitching Moment Intercept Due to Yaw - K_{INTC_4} Fuselage Interference Correction

3.4.3 Increment - Adjacent Store Interference

The discussion of pitching moment slope and intercept increments due to adjacent store interference is similar to that of side force found in Subsection 3.1.3.

3.4.3.1 Slope Prediction

The equation to predict incremental pitching moment slope, $\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}}$, for M = 0.5 is given below

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 281.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2., in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg.}$, Figure 282

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Section 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

A numerical example illustrating the use of the above equation is found in Subsection 3.1.3.1.

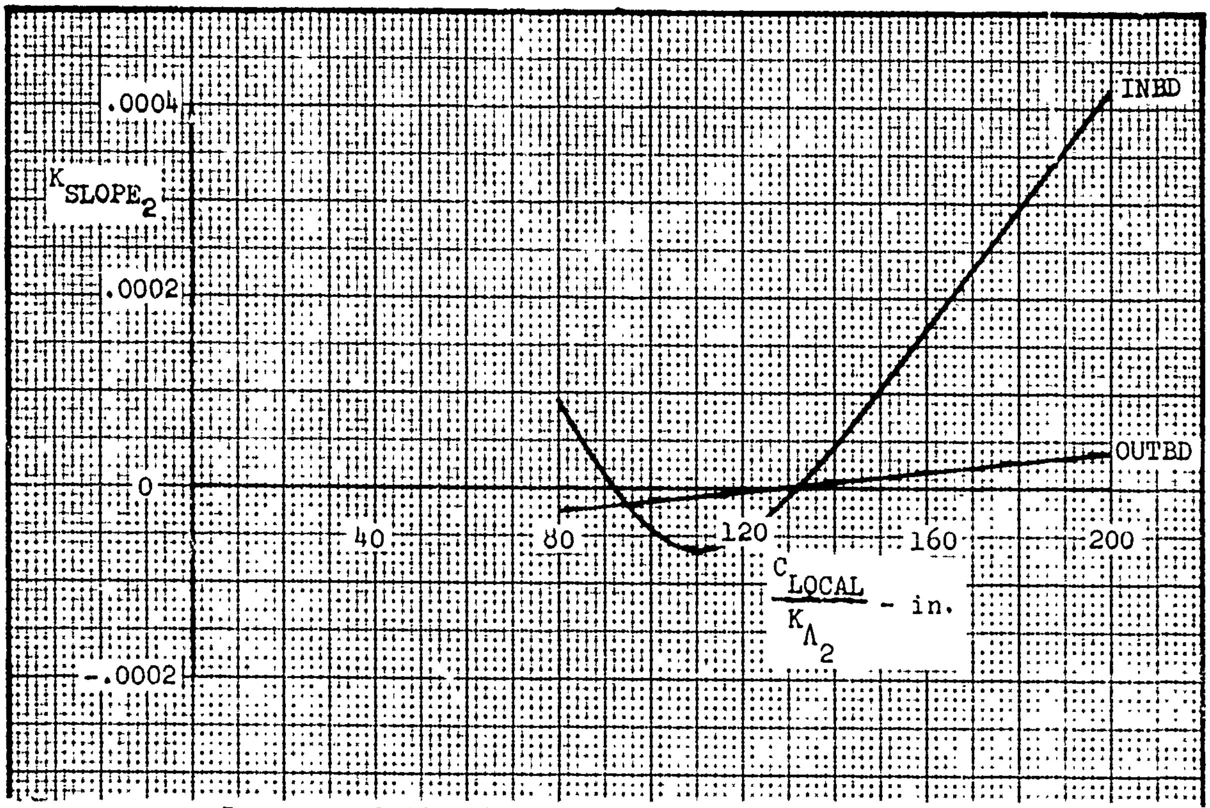

Figure 281. Incremental Pitching Moment Slope Due to Interference - K_{SLOPE_2} for Inboard and Outboard Interference M=0.5

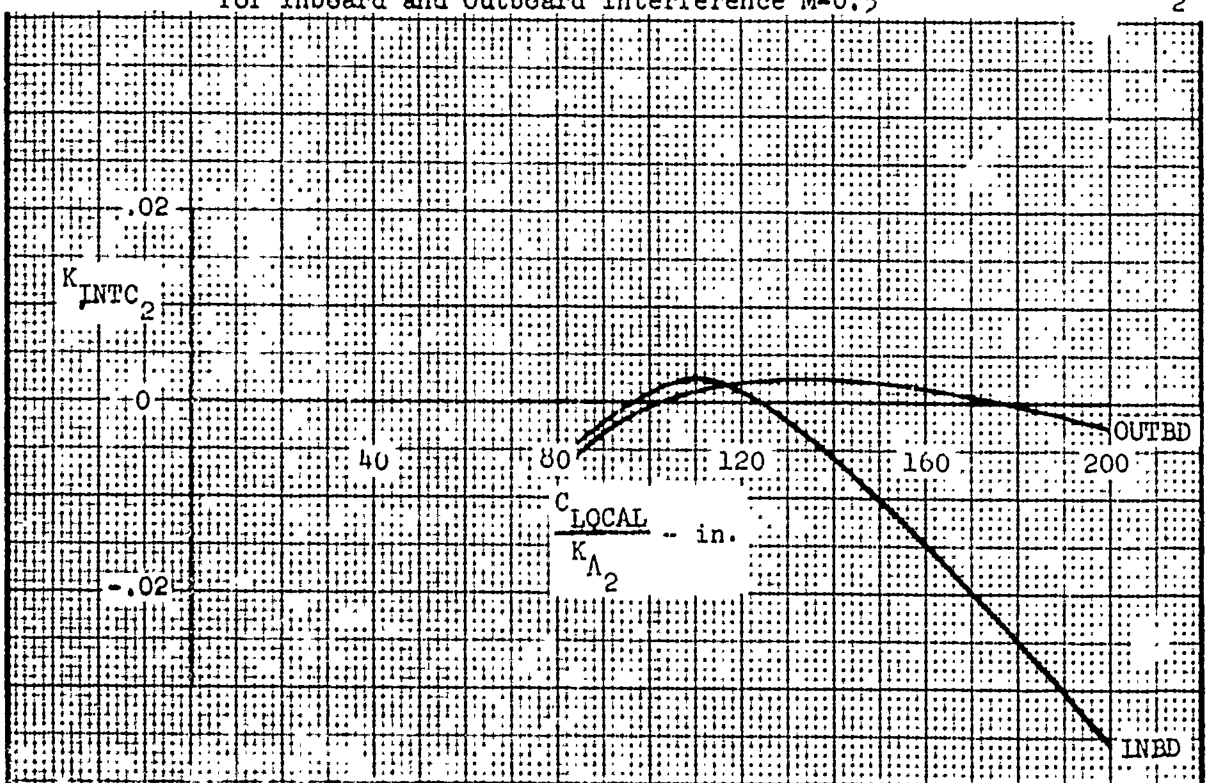

Figure 282. Incremental Pitching Moment Slope Due to Interference - K_{INTC_2} for Inboard and Outboard Interference M=0.5

3.4.3.2 Slope Mach Number Correction

To compute the variation in incremental pitching moment slope, $\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}}$, between M = 0.5 and M = 2.0, use the following expression.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=x}}} = \Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=0.5}}} + \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=x}}}$$

where:

$\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=0.5}}}$ - Incremental pitching moment slope at M = 0.5.

$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=x}}}$ - Incremental change with Mach number from the incremental pitching moment slope value at M = 0.5.

A generalized curve illustrating the incremental pitching moment slope variation with Mach number is given by Figure 283.

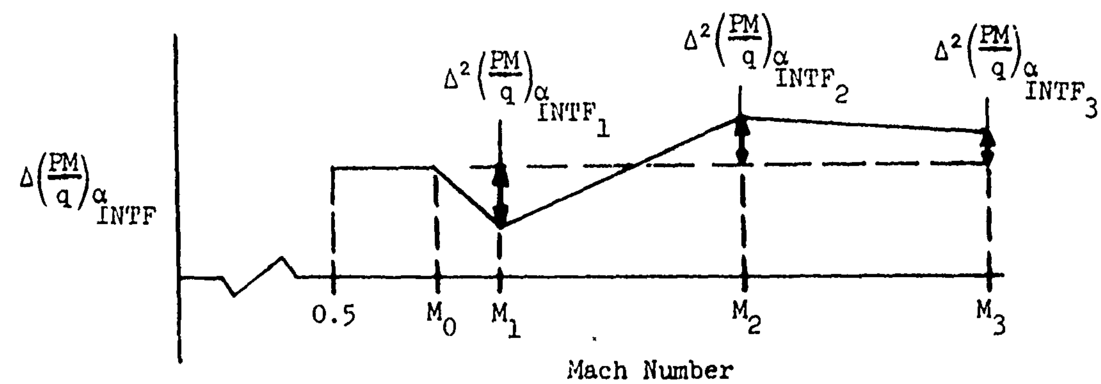

Figure 283. Incremental Pitching Moment Slope Due to Interference - Generalized Mach Number Variation

The incremental slope variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, and M_3. The

variation of the Mach break points is presented in Figure 284 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is the Mach number where the incremental slope initially deviates from the value predicted at M = 0.5. Equations to predict the incremental changes at the remaining Mach break points are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_1}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right) S_{REF} d$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{\text{in.} - \text{deg.}}$, Figure 285.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{\text{deg.}}$, Figure 286.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Break 2 (M_2):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_2}} = K_{SLOPE_3}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_3} = K_{SLOPE_4}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4}$$

and additionally,

K_{SLOPE_4} - Variation of K_{SLOPE_3} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 287.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_4} - Value of K_{SLOPE_3} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg.}$, Figure 288.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

Break 3 (M_3):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_3}} = K_{SLOPE_5}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_5} = K_{SLOPE_6}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_6}$$

and additionally,

K_{SLOPE_6} - Variation of K_{SLOPE_5} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in. - deg.}$, Figure 289.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_6} - Value of K_{SLOPE_5} when $\frac{ADJ.PPA}{L} = 0$, $\frac{1}{deg.}$, Figure 290.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

To compute $\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}}$ at $M = x$, first determine from Figure 284 between which Mach number break points $M = x$ occurs. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break. Then compute $\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}}$ at $M = x$ from the following equation.

$$\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=x}}} = \Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M=0.5}}} + \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M_{LOW}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right) \left[\Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M_{HI}}}} - \Delta^2\left(\frac{PM}{q}\right)_{\alpha_{INTF_{M_{LOW}}}}\right]$$

If $x > 1.6$, then $\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}}$ at $M = x$ equals the value given at $M = 1.6$.

If $x \leq M_0$, then $\Delta\left(\frac{PM}{q}\right)_{\alpha_{INTF}}$ at $M = x$ equals the value obtained in Subsection 3.4.3.1 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 3.2.2.2.

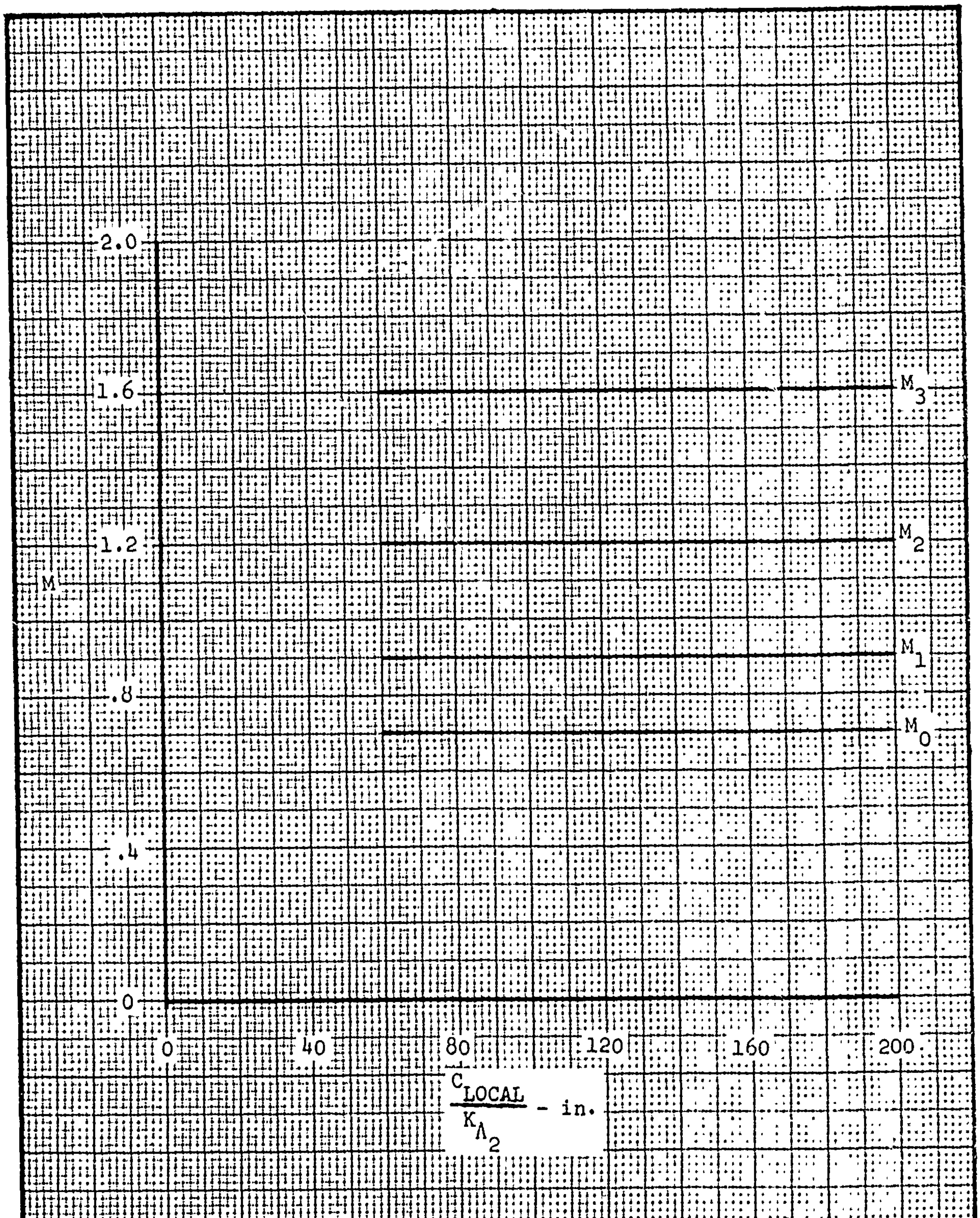

Figure 284. Incremental Pitching Moment Slope Due to Interference - Mach Number Break Points for Inboard and Outboard Interference

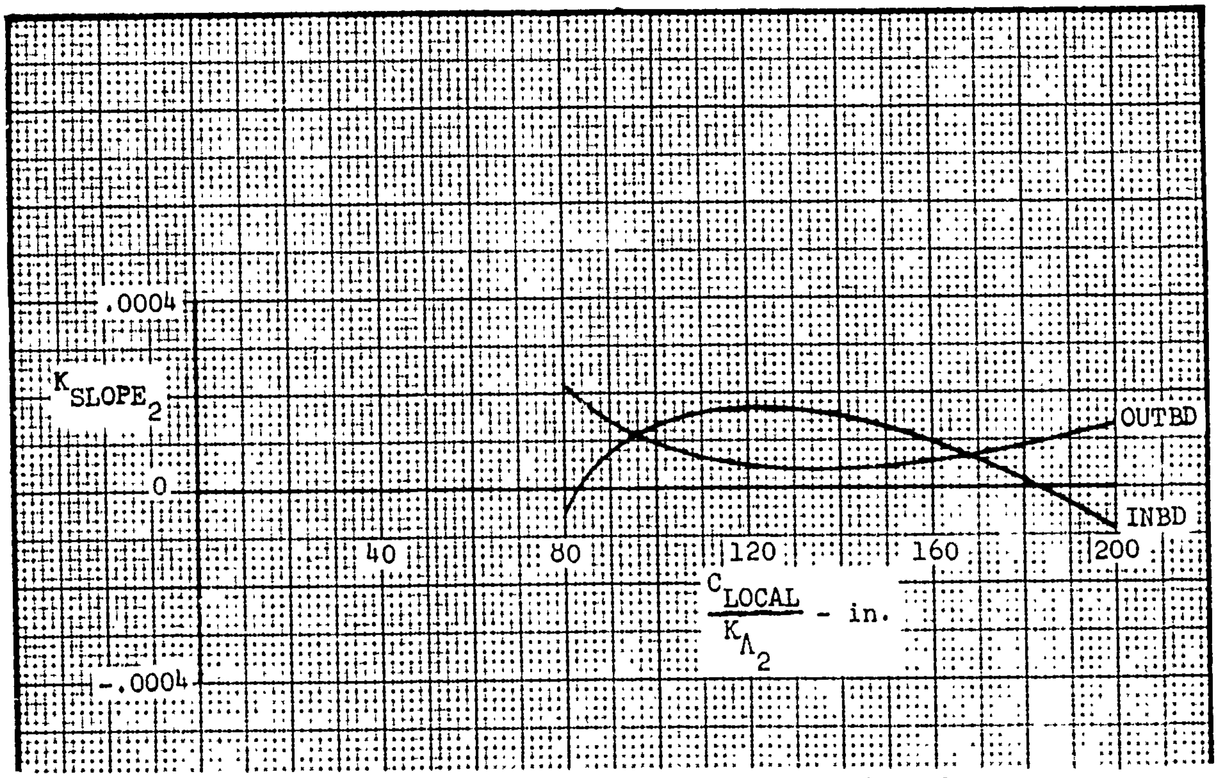

Figure 285. Incremental Pitching Moment Slope Due to Interference - K_{SLOPE_2} for Inboard and Outboard Adjacent Store Interference

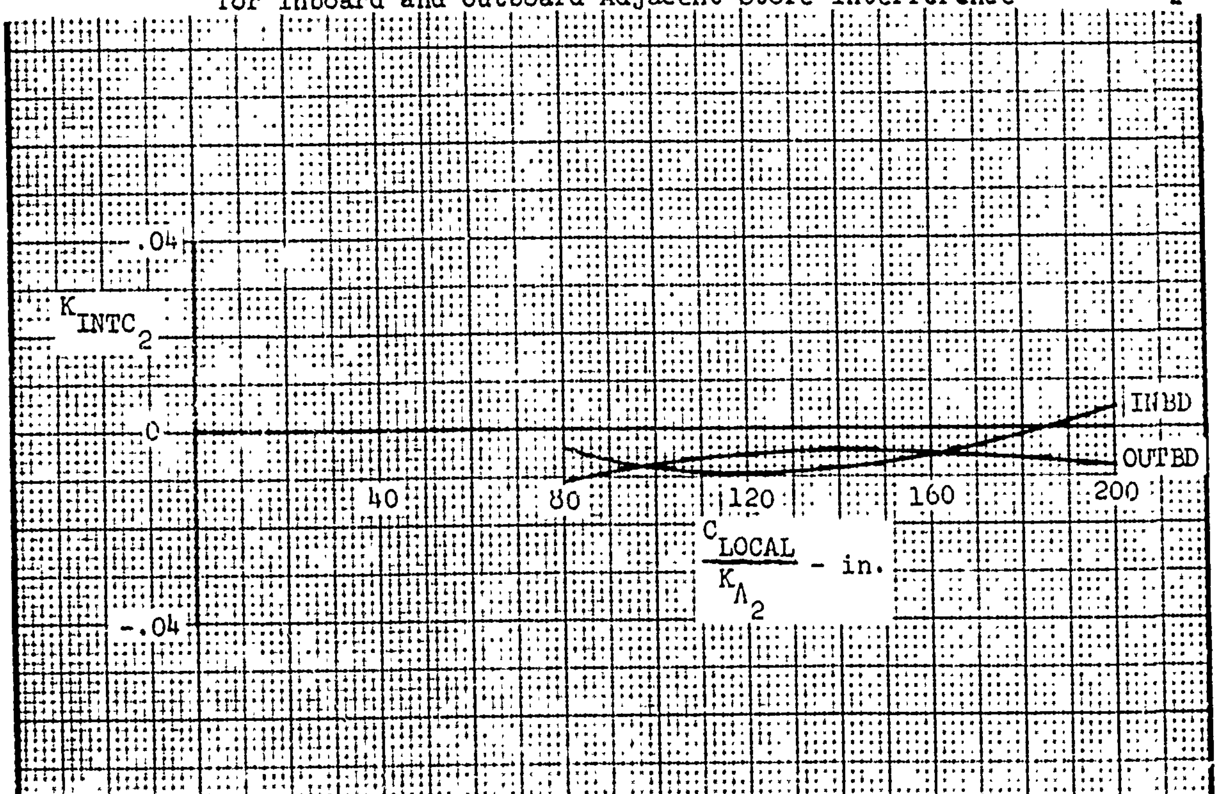

Figure 286. Incremental Pitching Moment Slope Due to Interference - K_{INTC_2} for Inboard and Outboard Adjacent Store Interference

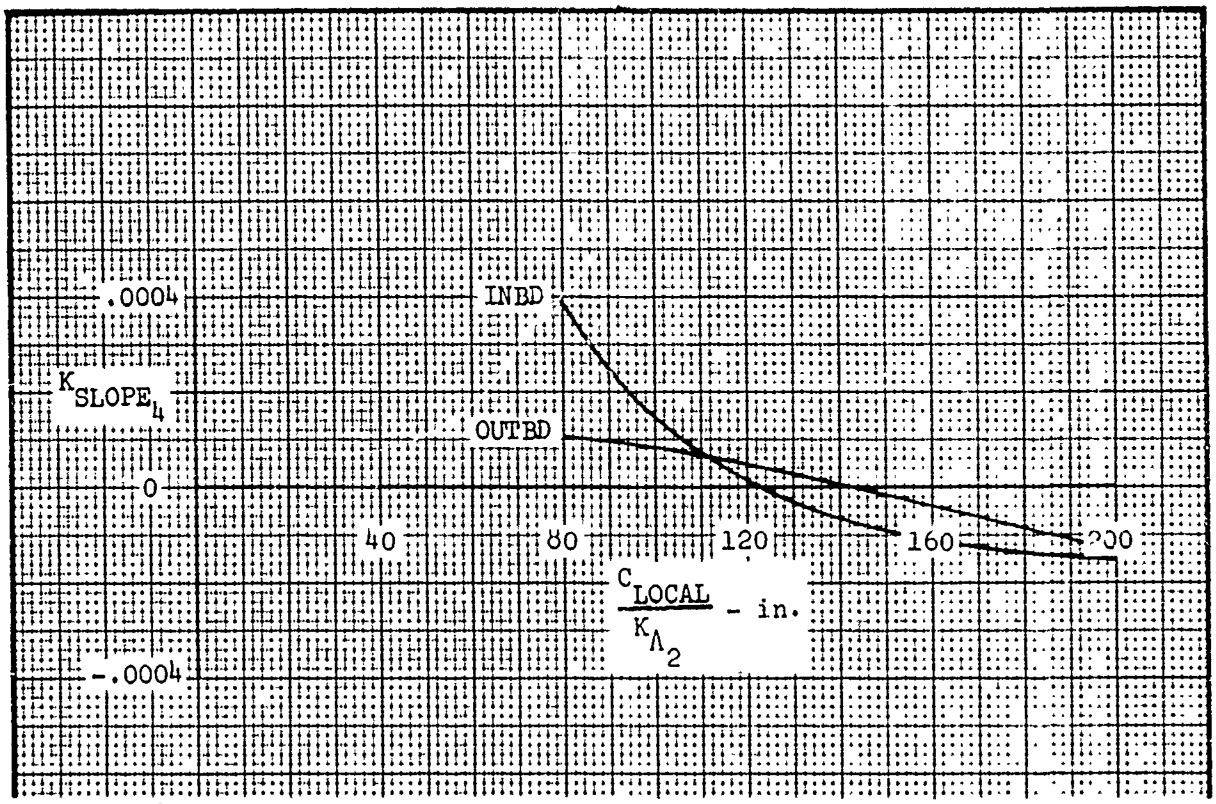

Figure 287. Incremental Pitching Moment Slope Due to Interference - K_{SLOPE_4} for Inboard and Outboard Adjacent Store Interference

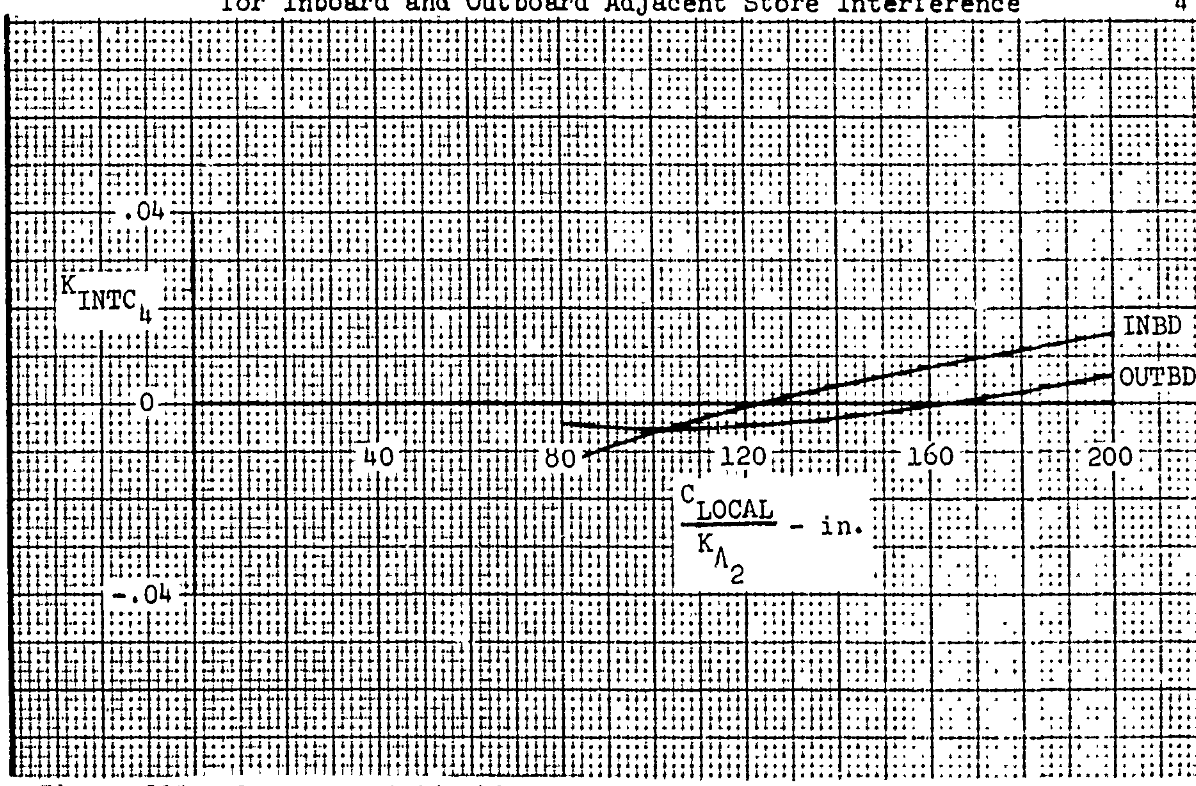

Figure 288. Incremental Pitching Moment Slope Due to Interference - K_{INTC_4} for Inboard and Outboard Adjacent Store Interference

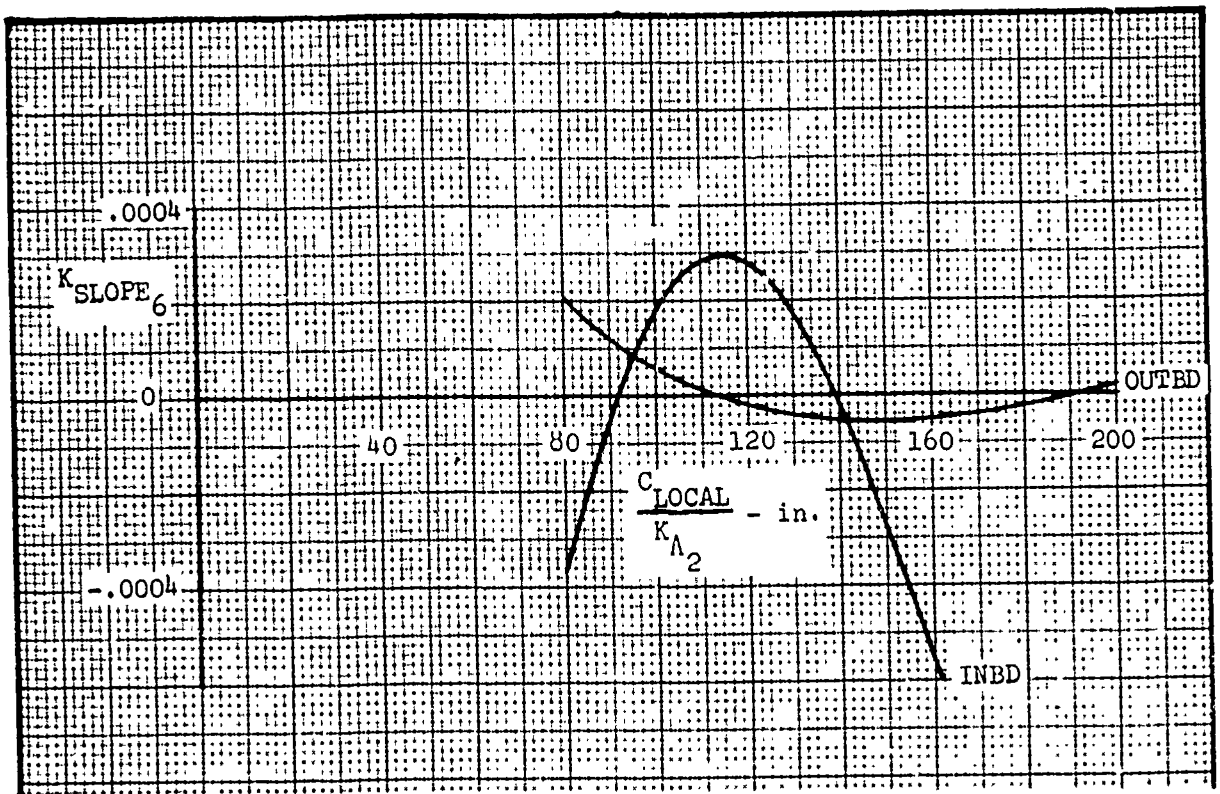

Figure 289. Incremental Pitching Moment Slope Due to Interference - K_{SLOPE_6} for Inboard and Outboard Adjacent Store Interference

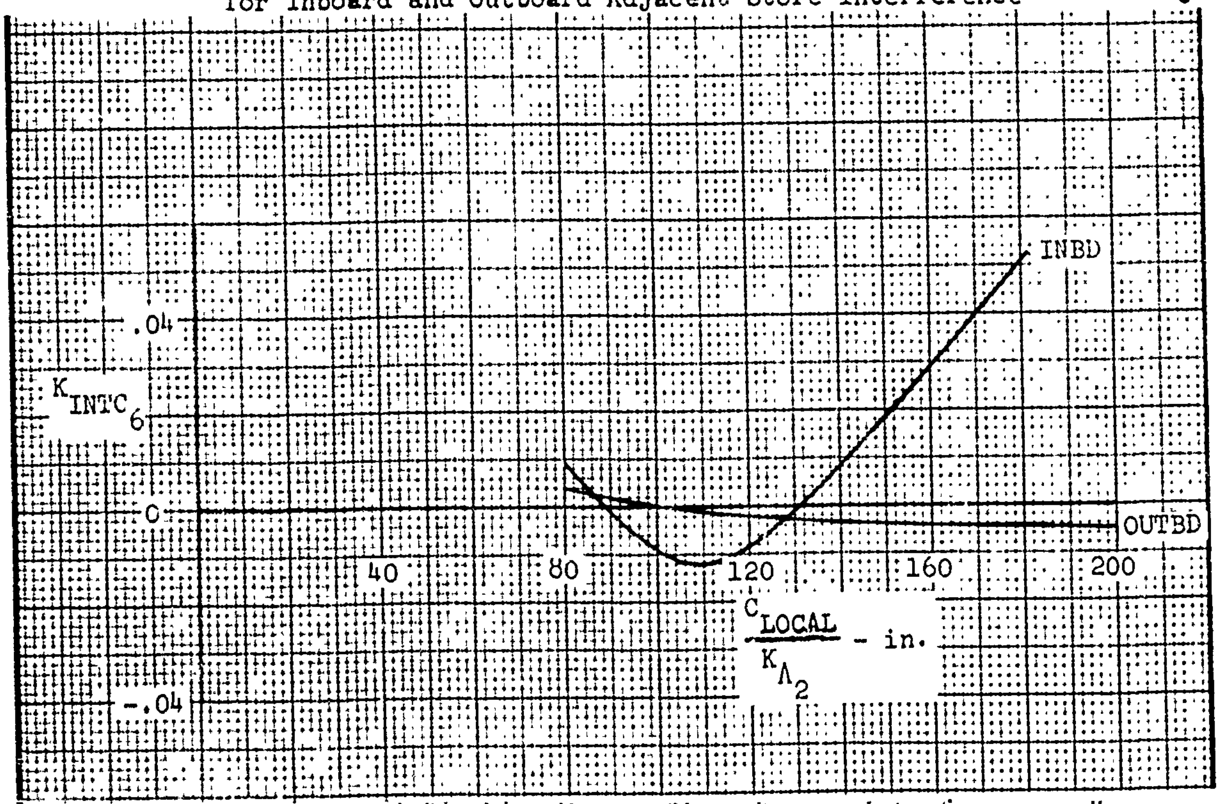

Figure 290. Incremental Pitching Moment Slope Due to Interference - K_{INTC_6} for Inboard and Outboard Adjacent Store Interference

3.4.3.3 Intercept Prediction

The equation to predict incremental pitching moment intercept, $\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\INTF}}$, for M = 0.5 is given below.

$$\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\INTF}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 291.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, Figure 292.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

A numerical example illustrating the use of the above equation is found in Subsection 3.1.3.1.

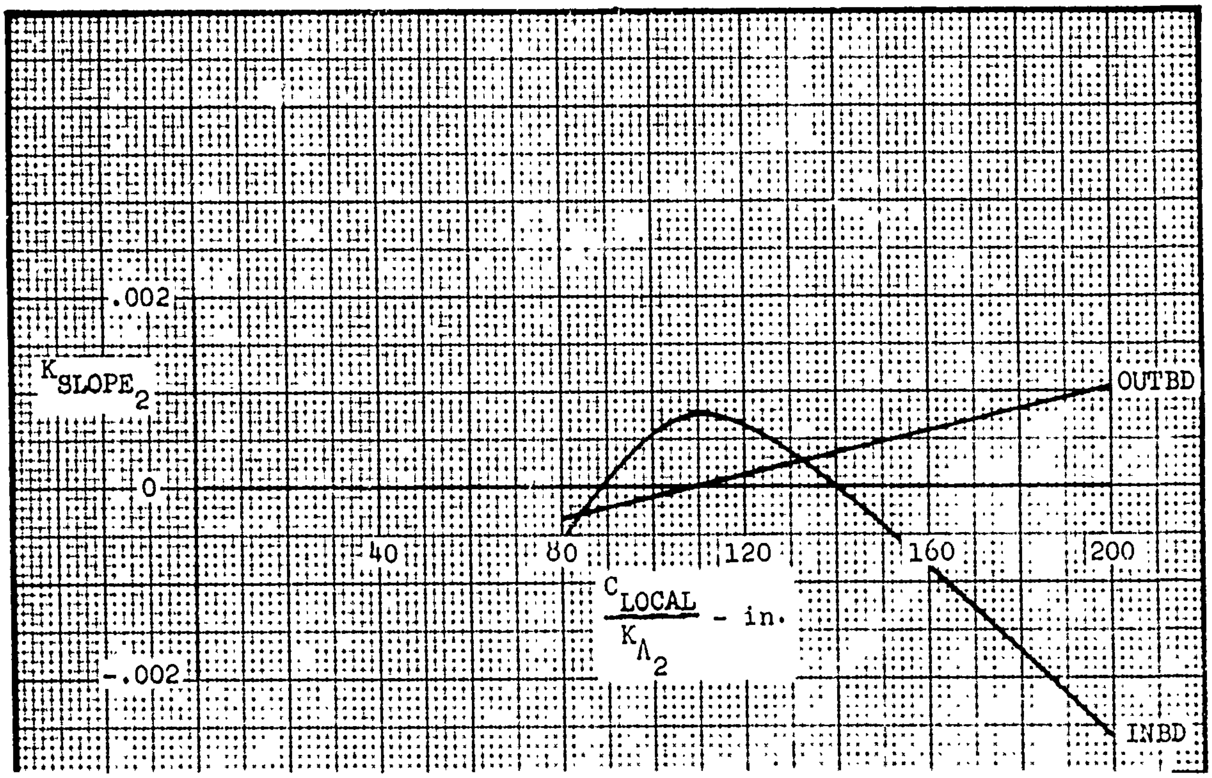

Figure 291. Incremental Pitching Moment Intercept Due to Interference - K_{SLOPE_2} for Inboard and Outboard Adjacent Store Interference M=0.5

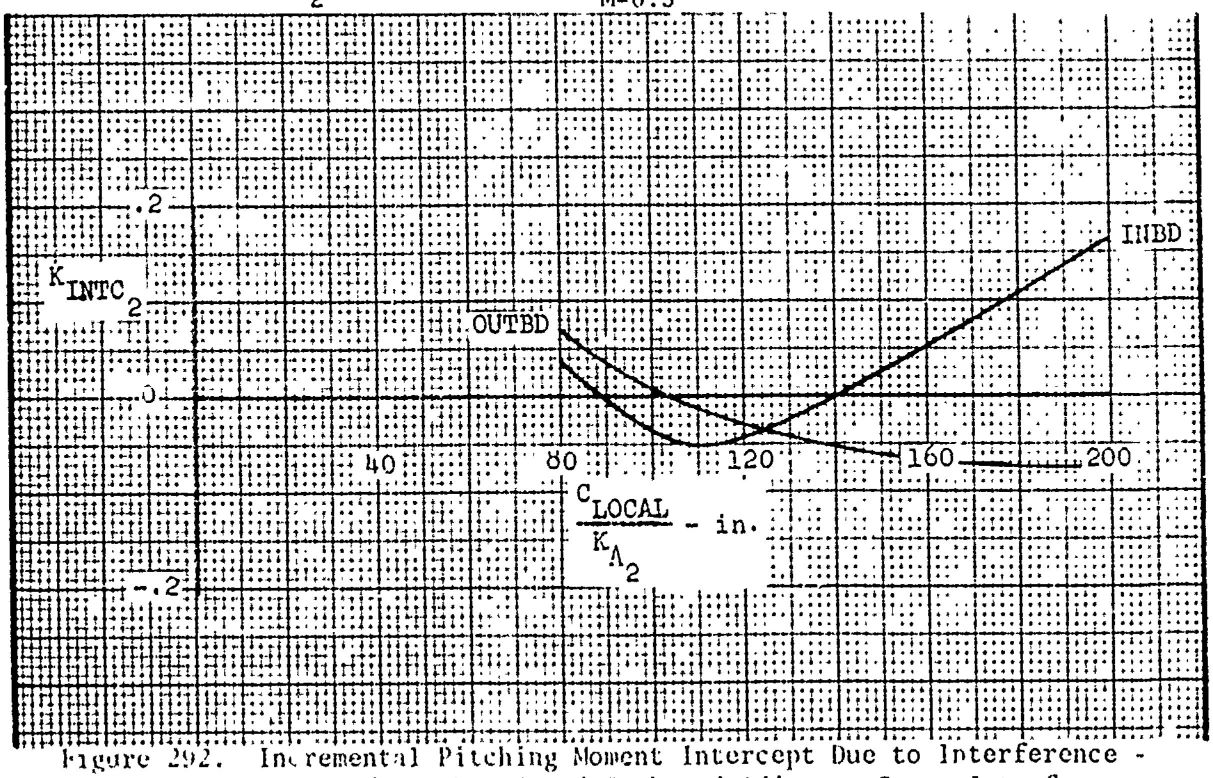

Figure 292. Incremental Pitching Moment Intercept Due to Interference - K_{INTC_2} for Inboard and Outboard Adjacent Store Interference M=0.5

3.4.3.4 Intercept Mach Number Correction

The procedure to compute the incremental pitching moment intercept between $M = 0.5$ and $M = 2.0$ is similar to that of incremental slope as found in Subsection 3.4.3.2.

A generalized curve depicting the incremental pitching moment intercept variation with Mach number is given by Figure 293.

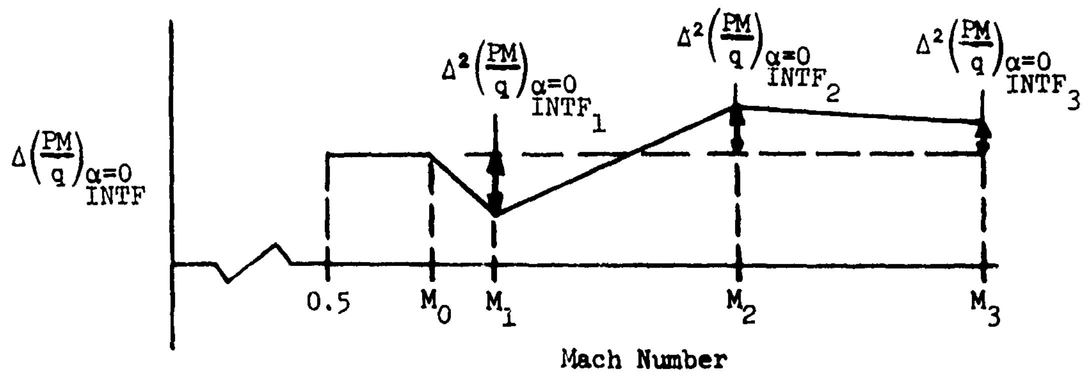

Figure 293. Incremental Pitching Moment Intercept Due to Interference - Generalized Mach Number Variation

The incremental intercept variation with Mach number has been approximated by a series of linear segments with break points occurring at Mach numbers defined by M_0, M_1, M_2, and M_3. The variation of the Mach break points is presented in Figure 294 as a function of $\frac{C_{LOCAL}}{K_{\Lambda_2}}$. M_0 is the Mach number where the incremental intercept initially deviates from the value predicted at $M = 0.5$. Equations to predict the incremental changes at the remaining Mach break points are presented below.

Break 1 (M_1):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{INTF_1}} = K_{SLOPE_1}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_1} = K_{SLOPE_2}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_2}$$

and additionally,

K_{SLOPE_2} - Variation of K_{SLOPE_1} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 295.

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_2} - Value of K_{SLOPE_1} when $\frac{ADJ.PPA}{L} = 0$, Figure 296.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ - Defined in Subsection 3.1.3.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Break 2 (M_2):

$$\Delta^2\left(\frac{PM}{q}\right)_{\alpha=0_{INTF_2}} = K_{SLOPE_3}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_3} = K_{SLOPE_4}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_4}$$

and additionally,

K_{SLOPE_4} - Variation of K_{SLOPE_3} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 297

$\frac{ADJ.PPA}{L}$ - Defined in Subsection 3.3.2.2, in.

K_{INTC_4} – Value of K_{SLOPE_3} when $\frac{ADJ.PPA}{L} = 0$, Figure 298.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ – Defined in Subsection 3.1.3.

S_{REF} – Store reference area, $\frac{\pi d^2}{4}$, ft².

Break 3 (M_3):

$$\Delta^2\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF_3}} = K_{SLOPE_5}\left(\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}\right)S_{REF}d$$

where:

$$K_{SLOPE_5} = K_{SLOPE_6}\left(\frac{ADJ.PPA}{L}\right) + K_{INTC_6}$$

and additionally,

K_{SLOPE_6} – Variation of K_{SLOPE_5} with $\frac{ADJ.PPA}{L}$, $\frac{1}{in.}$, Figure 299.

$\frac{ADJ.PPA}{L}$ – Defined in Subsection 3.3.2.2, in.

K_{INTC_6} – Value of K_{SLOPE_5} when $\frac{ADJ.PPA}{L} = 0$, Figure 300.

$\frac{d_{INTF}(x_{INTF} + 200)}{d \cdot y_{INTF}}$ – Defined in Subsection 3.1.3.

S_{REF} – Store reference area, $\frac{\pi d^2}{4}$, ft².

To compute $\Delta\left(\frac{PM}{q}\right)_{\alpha=0_{INTF}}$ at M = x, first determine from Figure 294 between which Mach number break points M = x occurs. Let M_{LOW}

be the lower Mach break and M_{HI} be the higher Mach break. Then compute $\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF}}$ at M = x from the following equation.

$$\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF_{M=x}}} = \Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF_{M=0.5}}} + \Delta^2\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF_{M_{LOW}}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)$$

$$\left[\Delta^2\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF_{M_{HI}}}} - \Delta^2\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF_{M_{LOW}}}}\right]$$

If $x > 1.6$, then $\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF}}$ at M = x equals the value given at M = 1.6.

If $x \leq M_0$, then $\Delta\left(\frac{PM}{q}\right)_{\substack{\alpha=0\\ INTF}}$ at M = x equals the value obtained in Subsection 3.4.3.3 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 3.2.2.2.

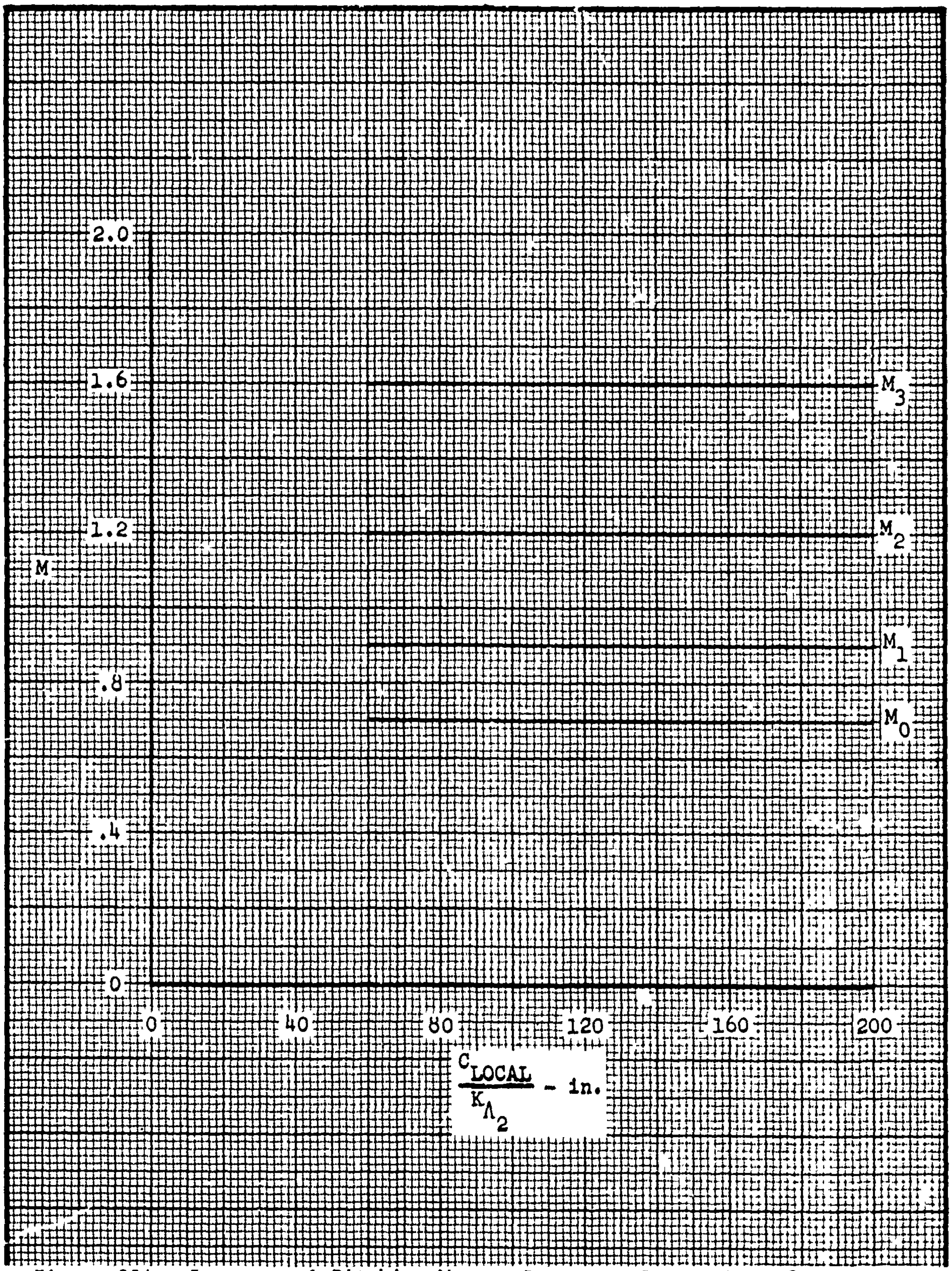

Figure 294. Incremental Pitching Moment Intercept Due to Interference - Mach Number Break Points for Inboard and Outboard Interference

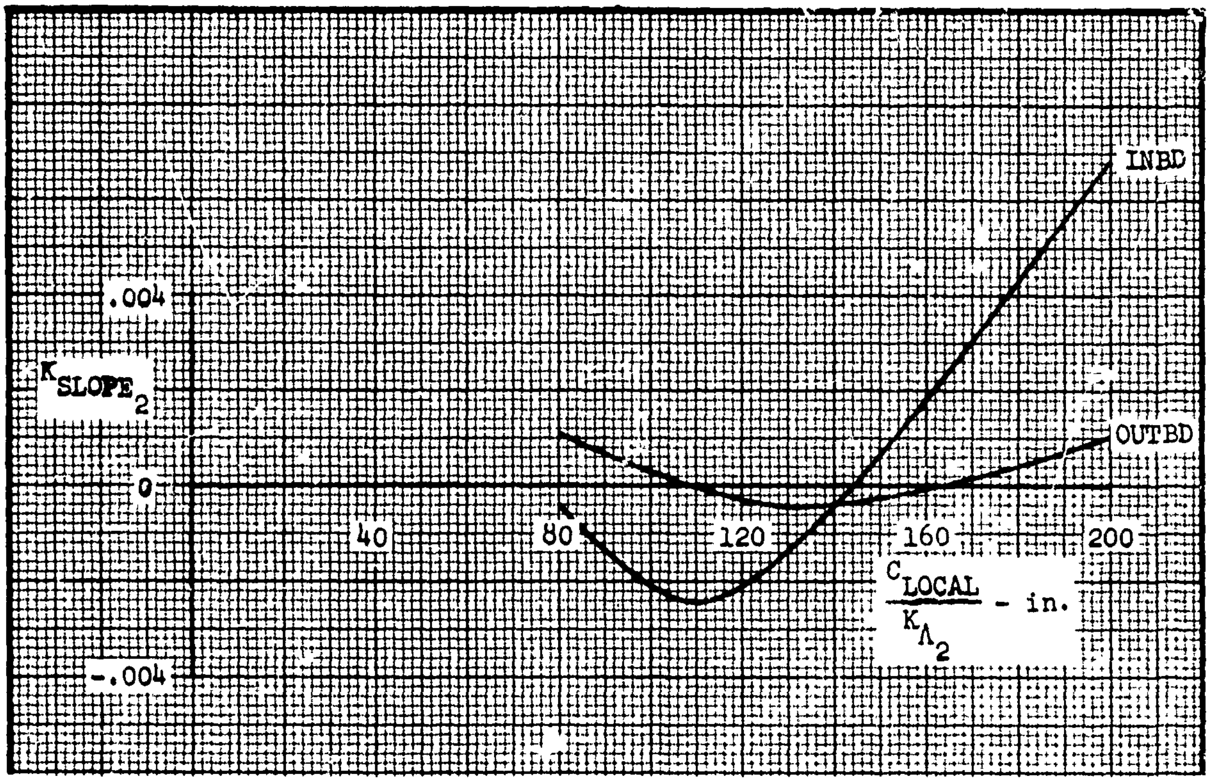

Figure 295. Incremental Pitching Moment Intercept Due to Interference - K_{SLOPE_2} for Inboard and Outboard Adjacent Store Interference

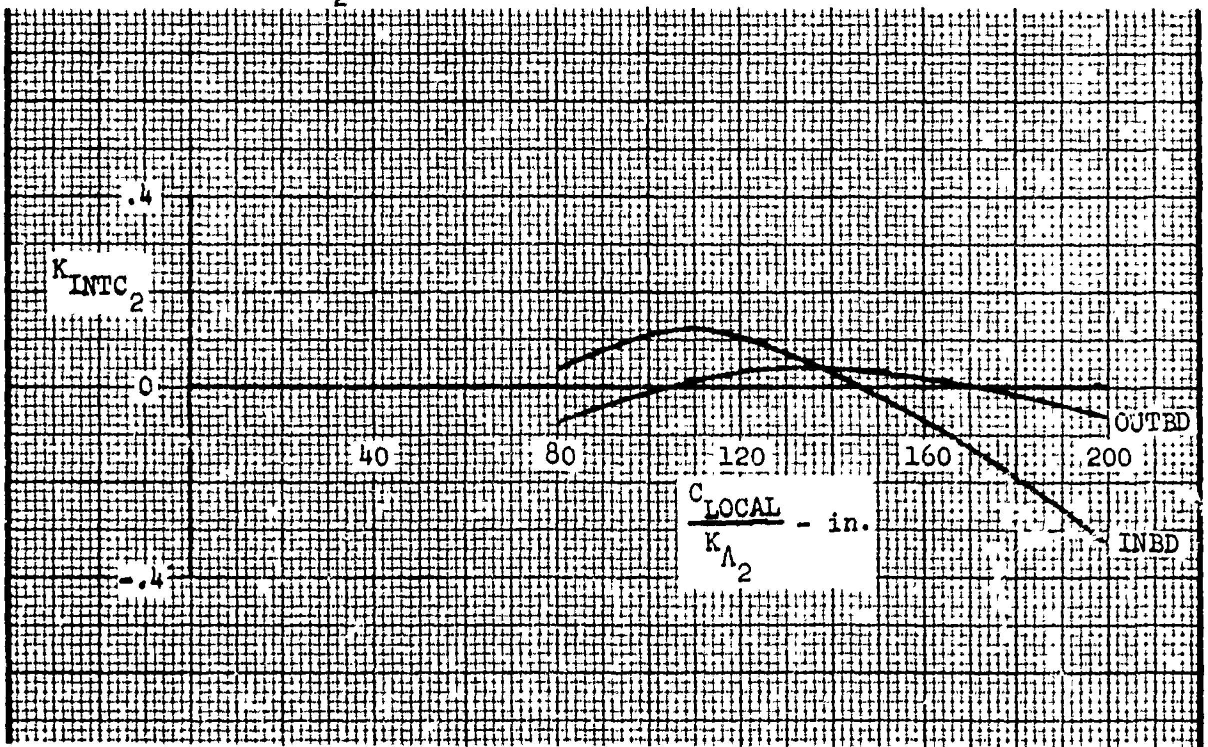

Figure 296. Incremental Pitching Moment Intercept Due to Interference - K_{INTC_2} for Inboard and Outboard Adjacent Store Interference

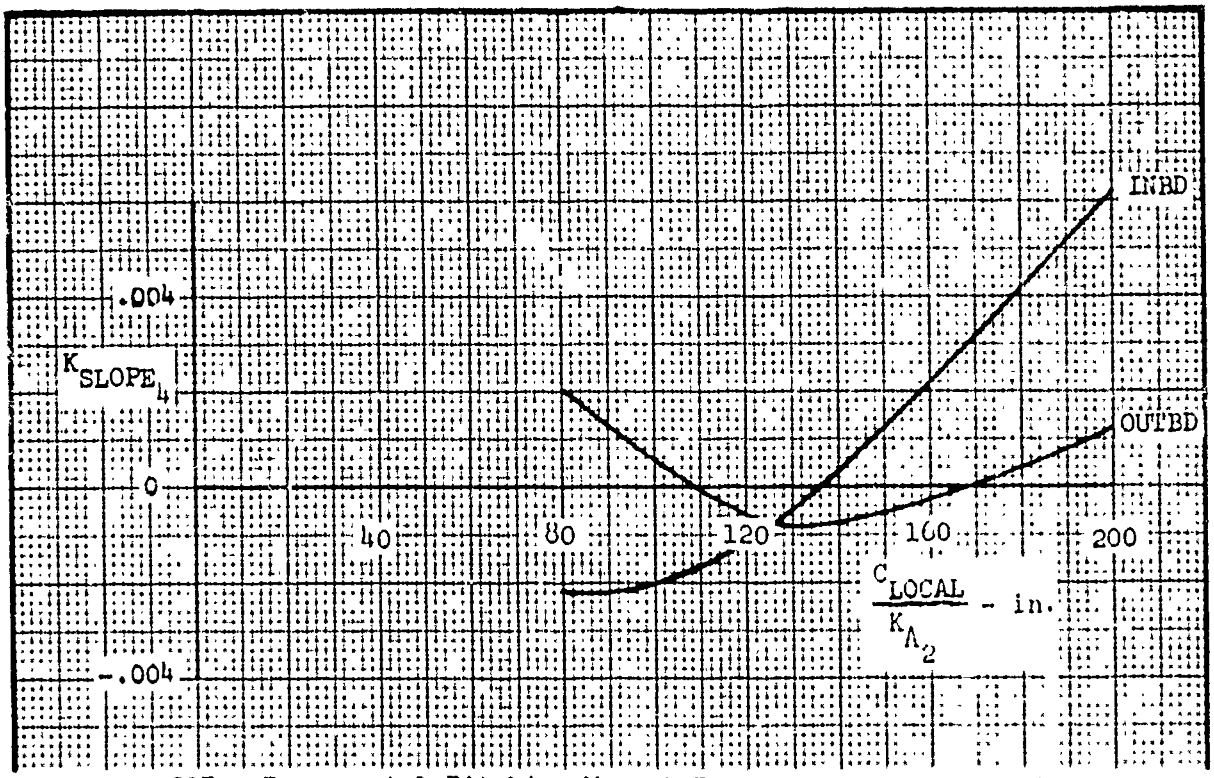

Figure 297. Incremental Pitching Moment Intercept Due to Interference - K_{SLOPE_4} for Inboard and Outboard Adjacent Store Interference

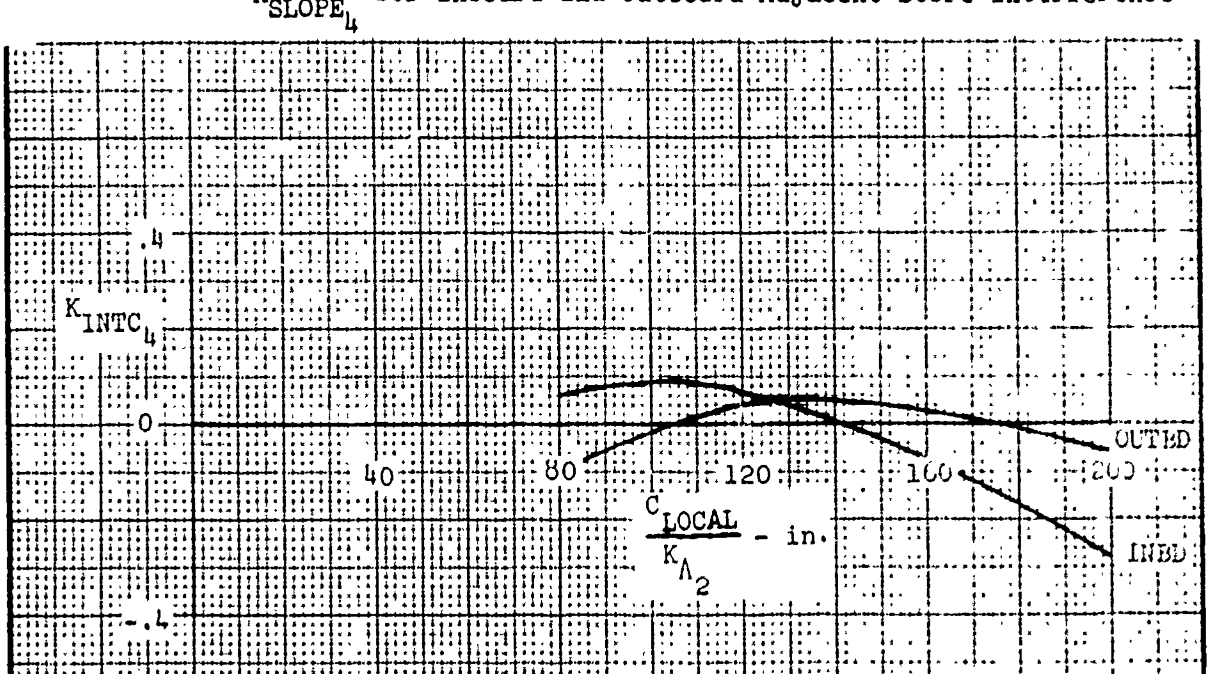

Figure 298. Incremental Pitching Moment Intercept Due to Interference K_{INTC_4} for Inboard and Outboard Adjacent Store Interference

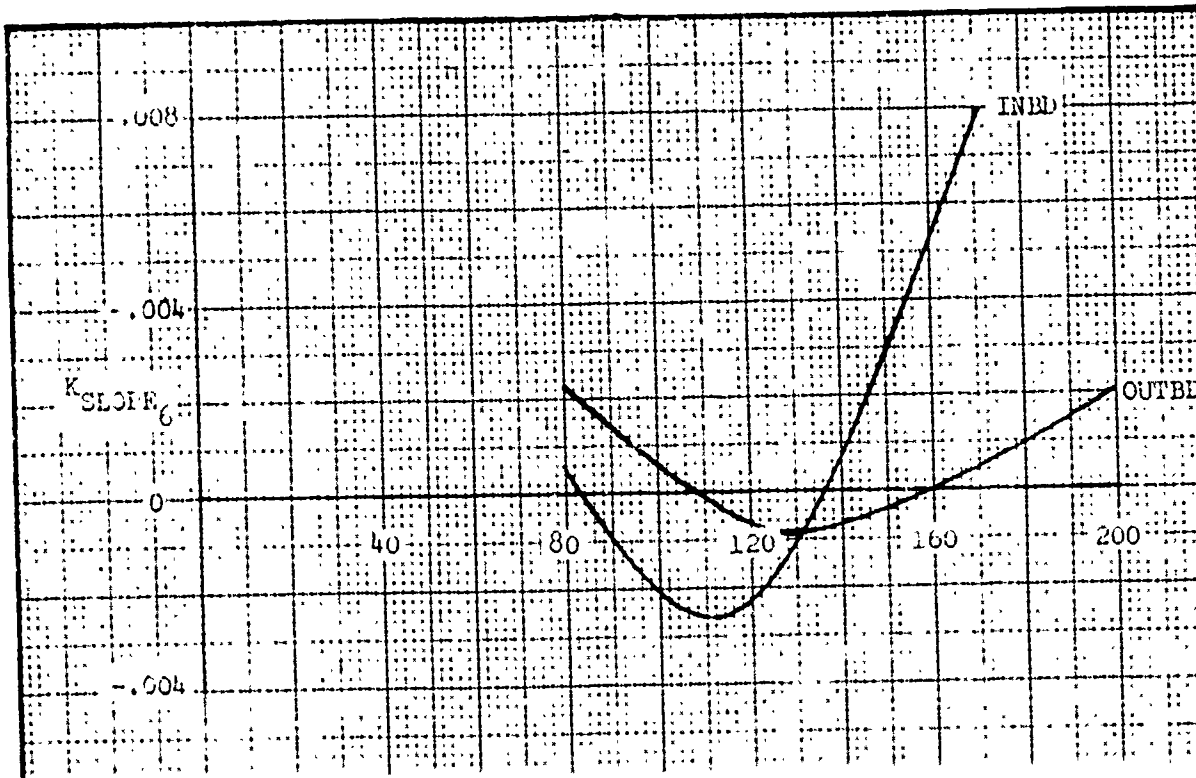

Figure 59. Incremental Pitching Moment Intercept Due to Interference K_{SLOPE_6} for Inboard and Outboard Adjacent Store Interference

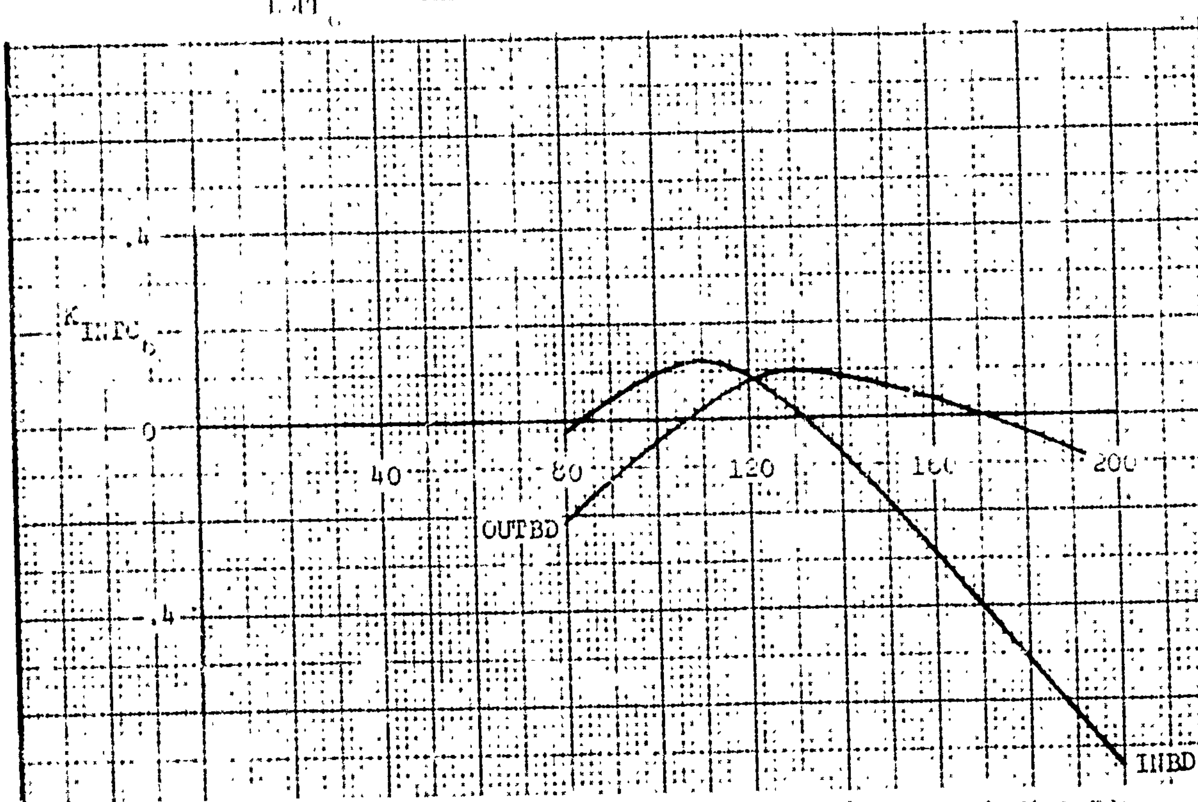

Figure 60. Incremental Pitching Moment Intercept Due to Interference K_{INTC_6} for Inboard or Outboard Adjacent Store Interference

[illegible].5 AXIAL FORCE

[illegible].5.1 Basic Airload

[illegible].5.1.1 Slope Prediction

The variation of captive store axial force with angle of attack is given by the following relationship.

$$\left(\frac{AF}{q}\right)_\alpha = \left[\left(\frac{AF}{qS_{REF}}\right)_{\alpha_{INST}} + \Delta\left(\frac{AF}{qS_{REF}}\right)_{\alpha_\eta} + \Delta\left(\frac{AF}{qS_{REF}}\right)_{\alpha_{INTF}} \right] S_{REF}$$

where:

$\left(\frac{AF}{qS_{REF}}\right)_{\alpha_{INST}}$ - Variation of axial force slope due to the basic installation on a wing pylon, $\frac{1}{deg.}$, Figure 301.

$$\left(\frac{AF}{qS_{REF}}\right)_{\alpha_{INST}} = f(M)$$

$\Delta\left(\frac{AF}{qS_{REF}}\right)_{\alpha_\eta}$ - Increment to the basic installation axial force slope due to spanwise position of the installed store, $\frac{1}{deg.}$, Figures 302 and 303.

$\Delta\left(\frac{AF}{qS_{REF}}\right)_{\alpha_{INTF}}$ - Increment to the basic installation axial force slope due to the interference effect of the fuselage for high-wing aircraft, $\frac{1}{deg.}$, Figure 304.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Example:

Calculate the axial force variation with angle of attack, $\left(\frac{AF}{q}\right)_\alpha$, for a 300-gallon tank on the A-7 center pylon at M = 0.5.

Required for Computation:

$M = 0.5$

$\eta = .418$

$\eta' = .270$

$$\left(\frac{\Delta l}{q}\right)_{LEF_{\alpha_{LEF}}} = -.000[illegible] \quad \text{- Figure 30?}$$

$$\ell\left(\frac{\Delta l}{q}\right)_{LEF_{\alpha}} = -.00[illegible] \quad \text{- Figure 30?}$$

$$\ell\left(\frac{\Delta l}{q}\right)_{LEF_{\alpha_{INTF}}} = 0 \quad \text{- Figure 304}$$

[illegible]:

$$\left(\frac{\Delta l}{q}\right) = (.0005 - .004 + 0)3.83 = -.0017 \frac{ft^2}{ft}$$

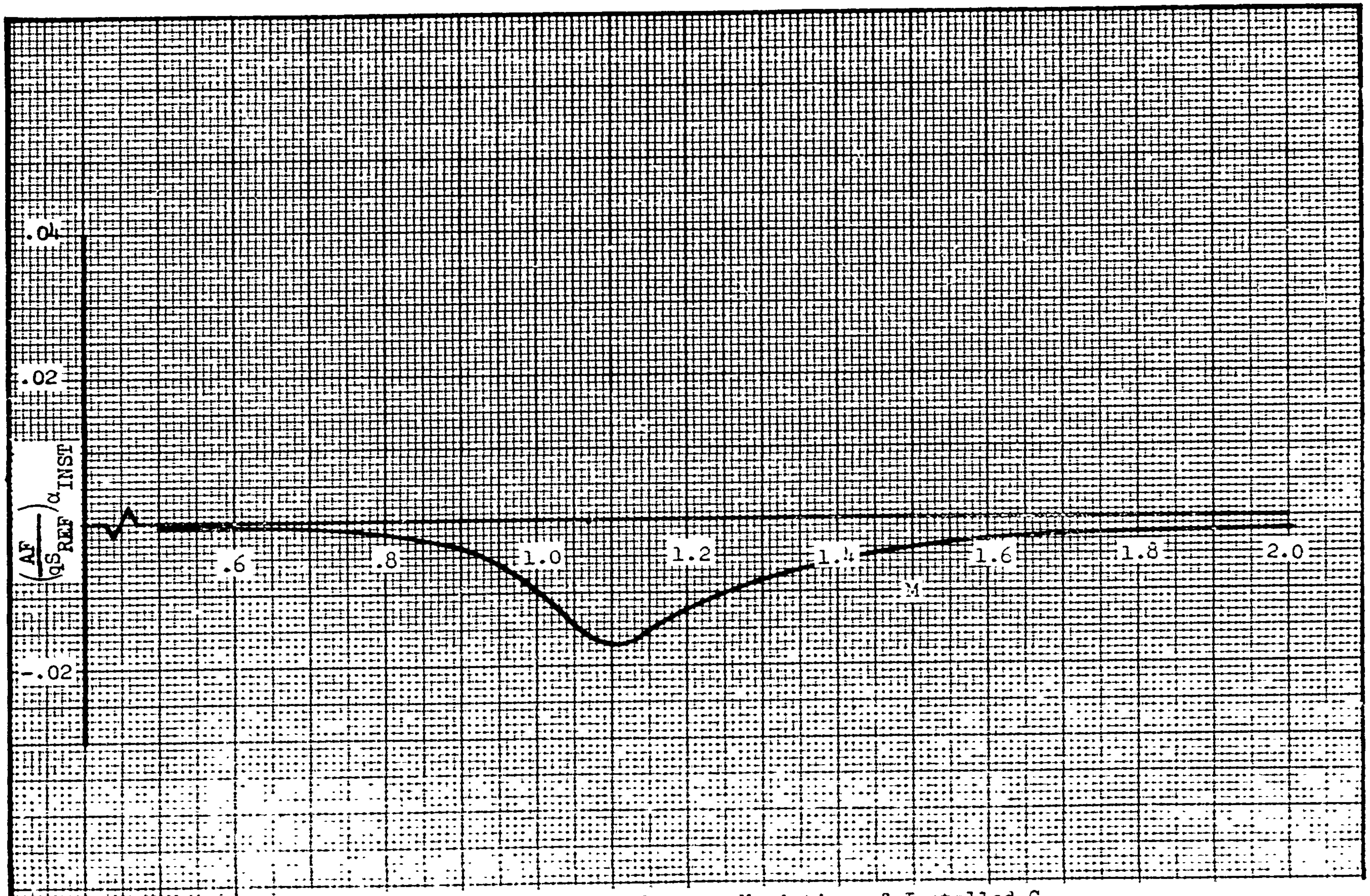

Figure 301. Axial Force Slope - Variation of Installed C_{A_α}

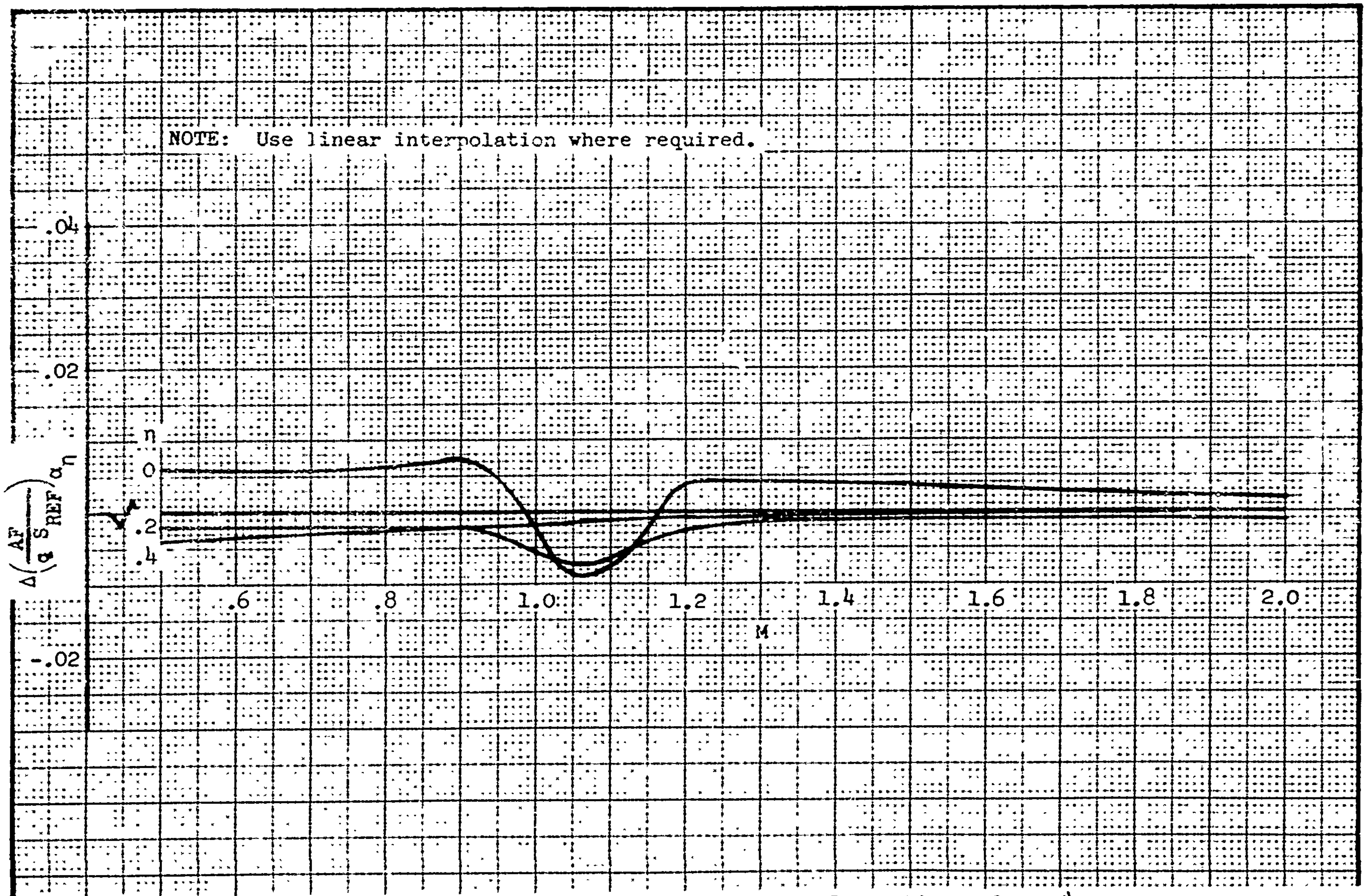

Figure 302. Axial Force Slope - Spanwise Correction η=0 to .4

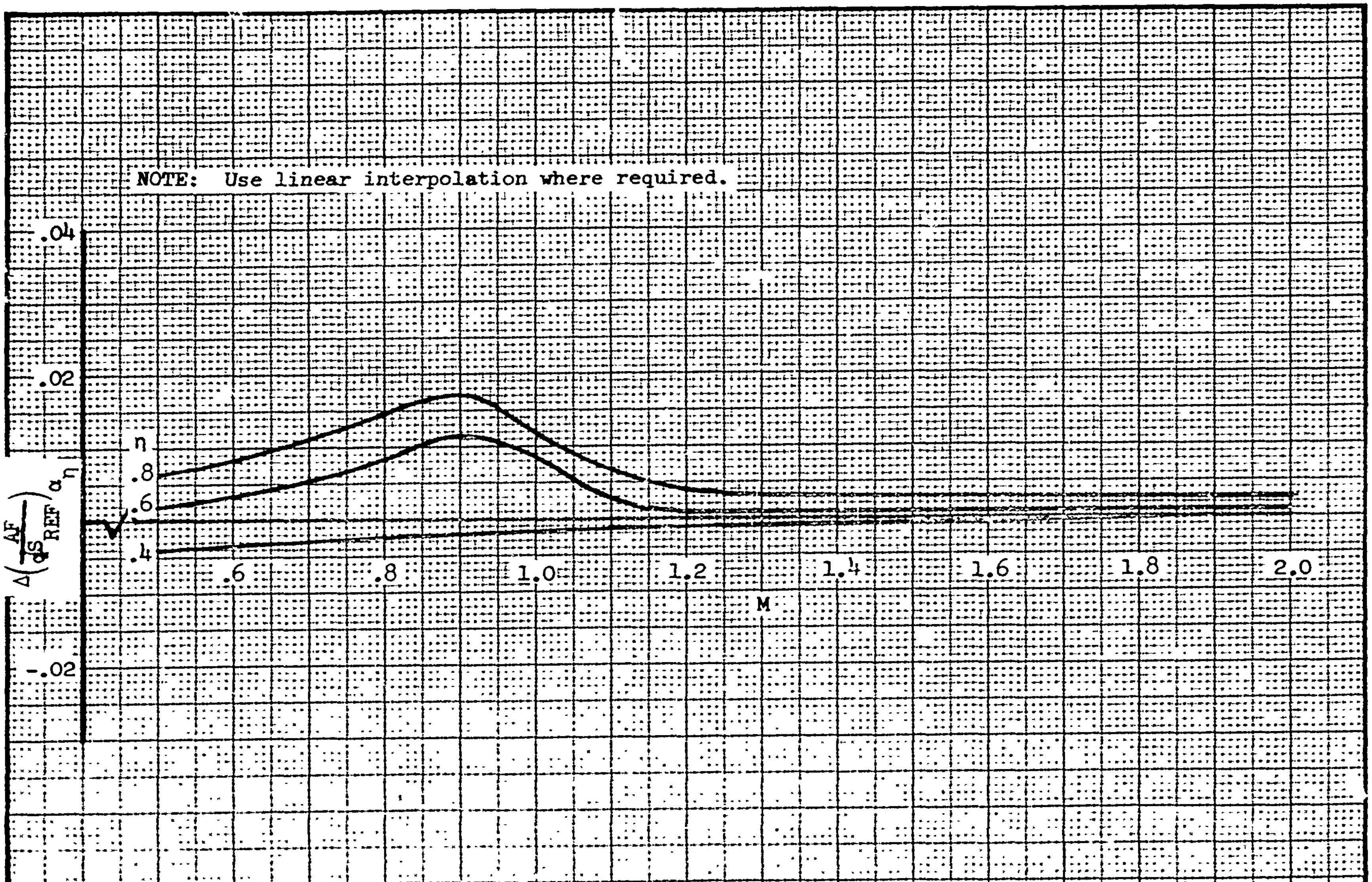

Figure 303. Axial Force Slope - Spanwise Correction η=.4 to .8

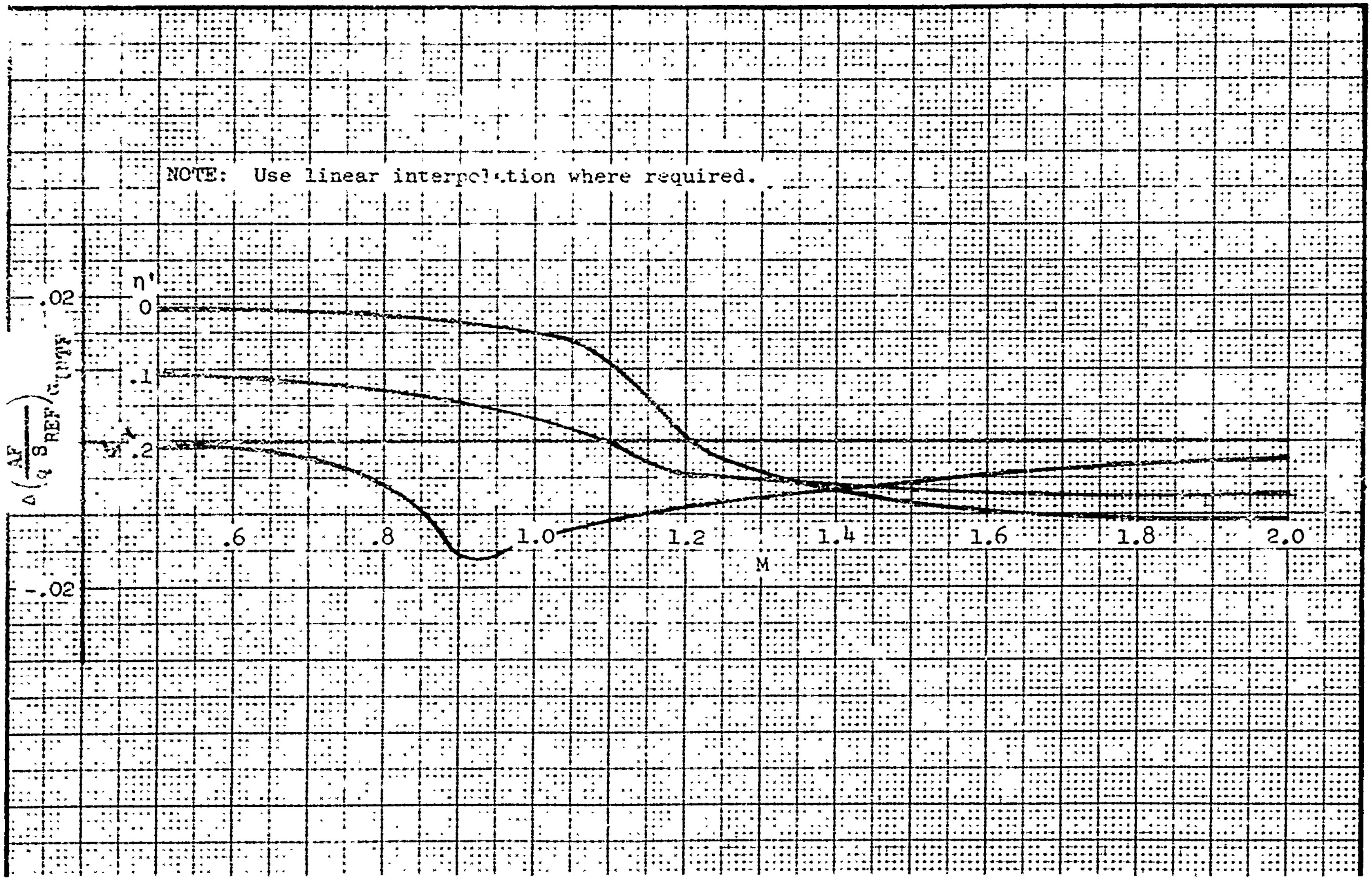

Figure 304. Axial Force Slope - Fuselage Interference Correction

3.5.1.2 Intercept Prediction

The axial force intercept, $\left(\frac{AF}{q}\right)_{\alpha=0}$, is given by the following relationship.

$$\left(\frac{AF}{q}\right)_{\alpha=0} = \left[\left(\frac{AF}{qS_{REF}}\right)_{\substack{\alpha=0\\ ISO}} + \Delta\left(\frac{AF}{qS_{REF}}\right)_{\substack{\alpha=0\\ INTF}}\right](1 + K_\eta + K_{INTF})S_{REF}$$

where:

$\left(\frac{AF}{qS_{REF}}\right)_{\substack{\alpha=0\\ ISO}}$ - Zero angle of attack axial force for the isolated store as obtained by the method of Subsection 2.2.1.

$\Delta\left(\frac{AF}{qS_{REF}}\right)_{\substack{\alpha=0\\ INTF}}$ - Increment to $C_{A_{\alpha=0}}$ as a function of wing shadowed store area, Figure 305. Wing shadowed store area is the store plan projected area aft of the wing leading edge.

K_η - Store spanwise position correction factor, Figures 306 and 307.

K_{INTF} - Correction factor accounting for the interference effect of the fuselage for high-wing aircraft, Figure 308.

Example:

Calculate the axial force intercept, $\left(\frac{AF}{q}\right)_{\alpha=0}$, for a 300-gallon tank on the A-7 center pylon at M = 0.5.

Required for Computation:

$\eta = .418$

$\eta' = .270$

Shadowed Area = 24.4 ft^2.

$\left(\frac{AF}{qS_{REF}}\right)_{\substack{\alpha=0\\ ISO}} = .064$ from Subsection 2.2.1.

$$\Delta\left(\frac{AF}{qS_{REF}}\right)_{\substack{\alpha=0\\ INTF}} = .098 \text{ - Figure 305}$$

$$K_{\eta} = .050 \qquad \text{- Figure 306}$$

$$K_{INTF} = 0 \qquad \text{- Figure 308}$$

Substituting,

$$\left(\frac{AF}{q}\right)_{\alpha=0} = (.064 + .098)(1 + .05 + 0)\ 3.83 = .651 \text{ ft}^2$$

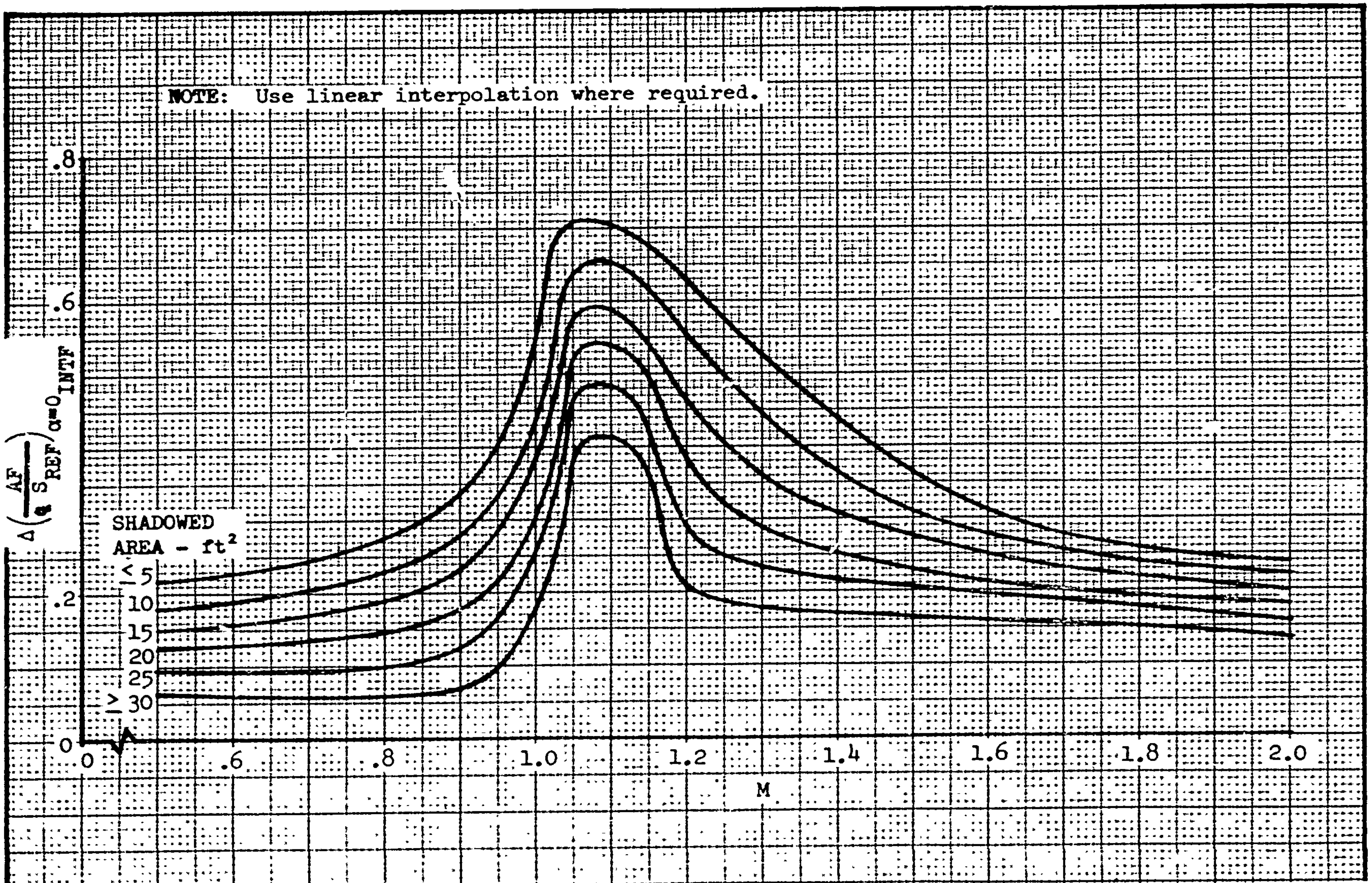

Figure 305. Axial Force Intercept - Incremental $C_{A_{\alpha=0}}$ due to installation

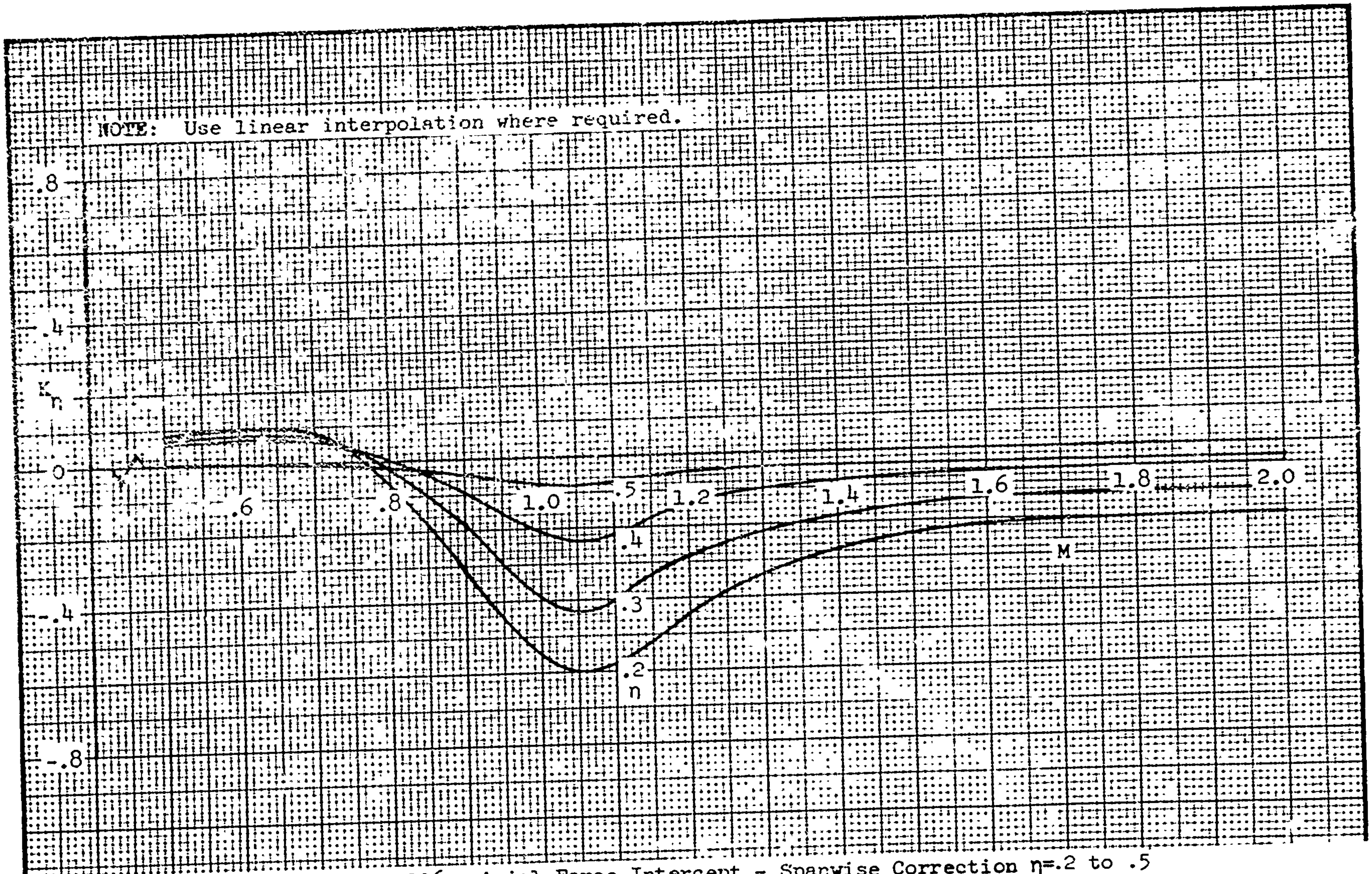

Figure 306. Axial Force Intercept - Spanwise Correction η=.2 to .5

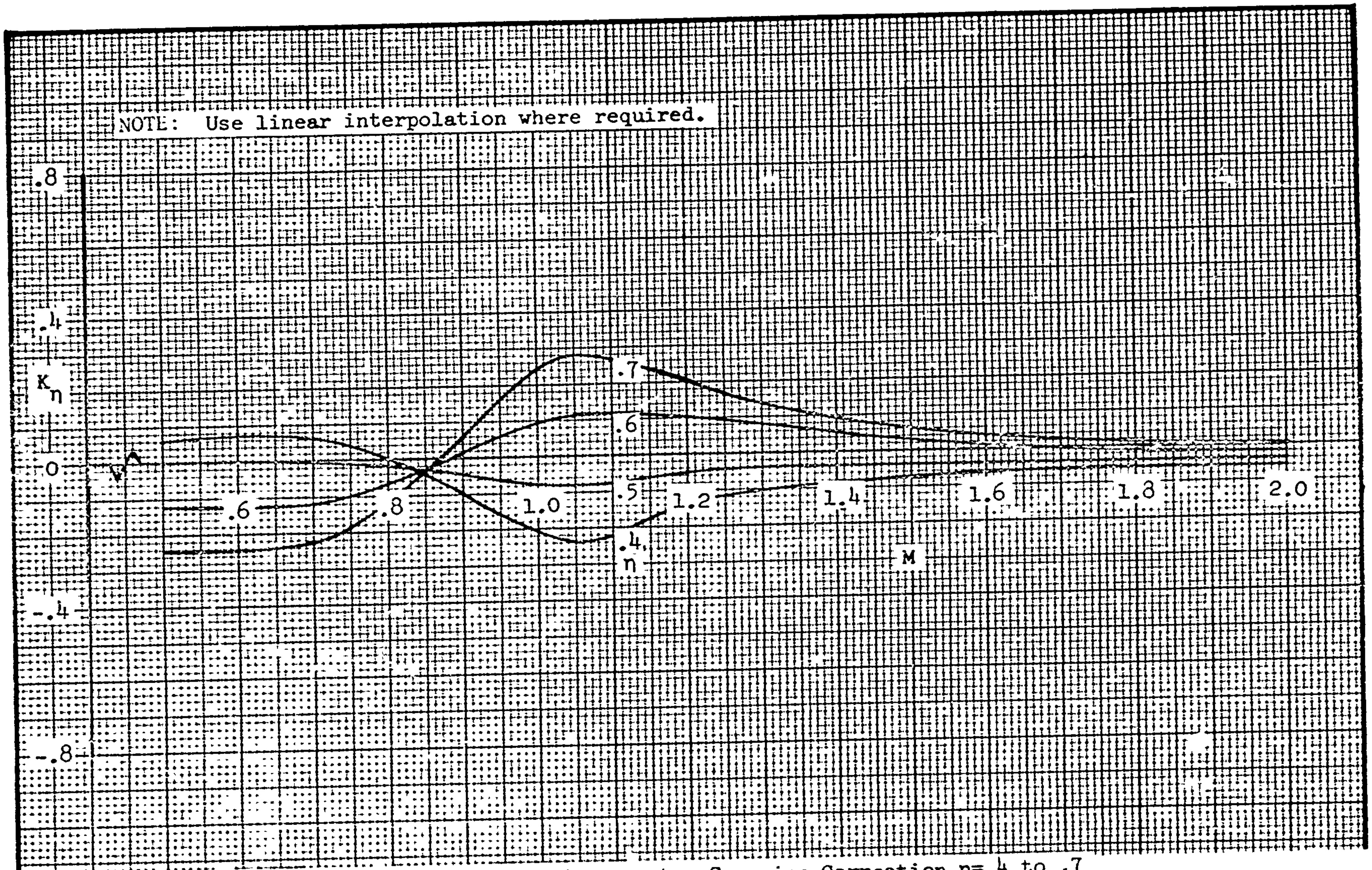

Figure 307. Axial Force Intercept - Spanwise Correction η=.4 to .7

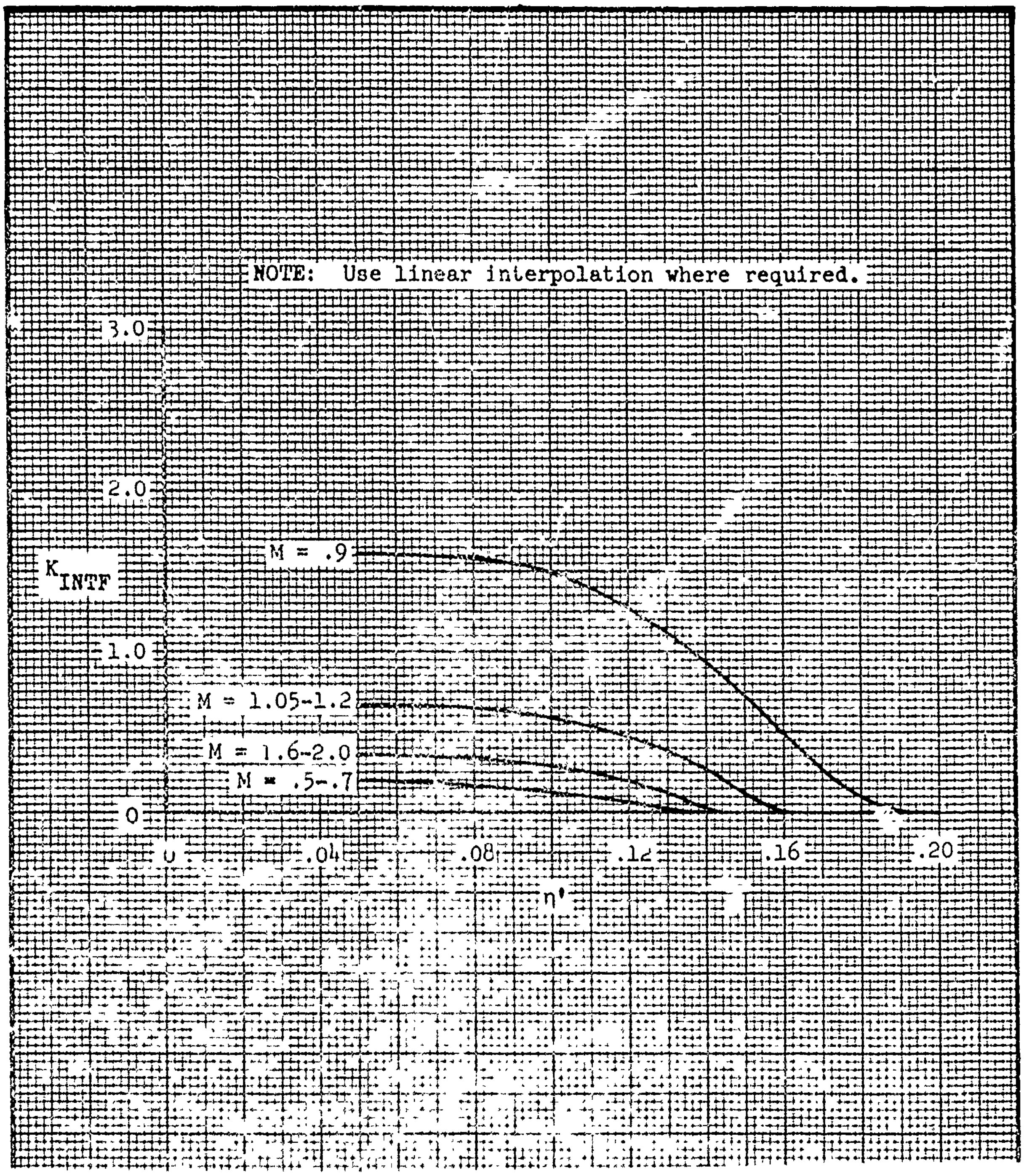

Figure 308. Axial Force Intercept Fuselage Interference Correction

3.5.2 Increment - Aircraft Yaw

The discussion of incremental changes in axial force due to aircraft yaw is analogous to the discussion of side force as found in Subsection 3.1.2.

3.5.2.1 Slope Prediction

The equation to predict incremental axial force slope per degree β_S, $\Delta\left(\frac{AF}{q}\right)_{\alpha_{\beta_S}}$, is given below.

$$\Delta\left(\frac{AF}{q}\right)_{\alpha_{\beta_S}} = K_{SLOPE_1} \cdot S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental C_{A_α} per degree β_S with S_{REF}, $\frac{1}{deg^2}$, Figure 309.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

Example: Calculate $\Delta\left(\frac{AF}{q}\right)_\alpha$ for a 300-gallon tank on the A-7 center pylon at $M = 0.9$ and $\beta_S = 4°$.

Required for Computation:

$S_{REF} = 3.83\ ft^2$.

$M = 0.9$

$\beta_S = 4°$

$K_{SLOPE_1} = .00038$ - Figure 309, + β_S

Substitute.

$$\Delta\left(\frac{AF}{q}\right)_{\alpha_{\beta_S}} = (.00038)3.83$$
$$= .00145\ \frac{ft^2.}{deg^2.}$$

and using the equation of Subsection 3.5.2

$$\Delta\left(\frac{AF}{q}\right)_{\alpha} = \Delta\left(\frac{AF}{q}\right)_{\alpha_{\beta_S}} \cdot \beta_S$$

$$= (.00145)4$$
$$= .0058\ \frac{ft^2.}{deg.}$$

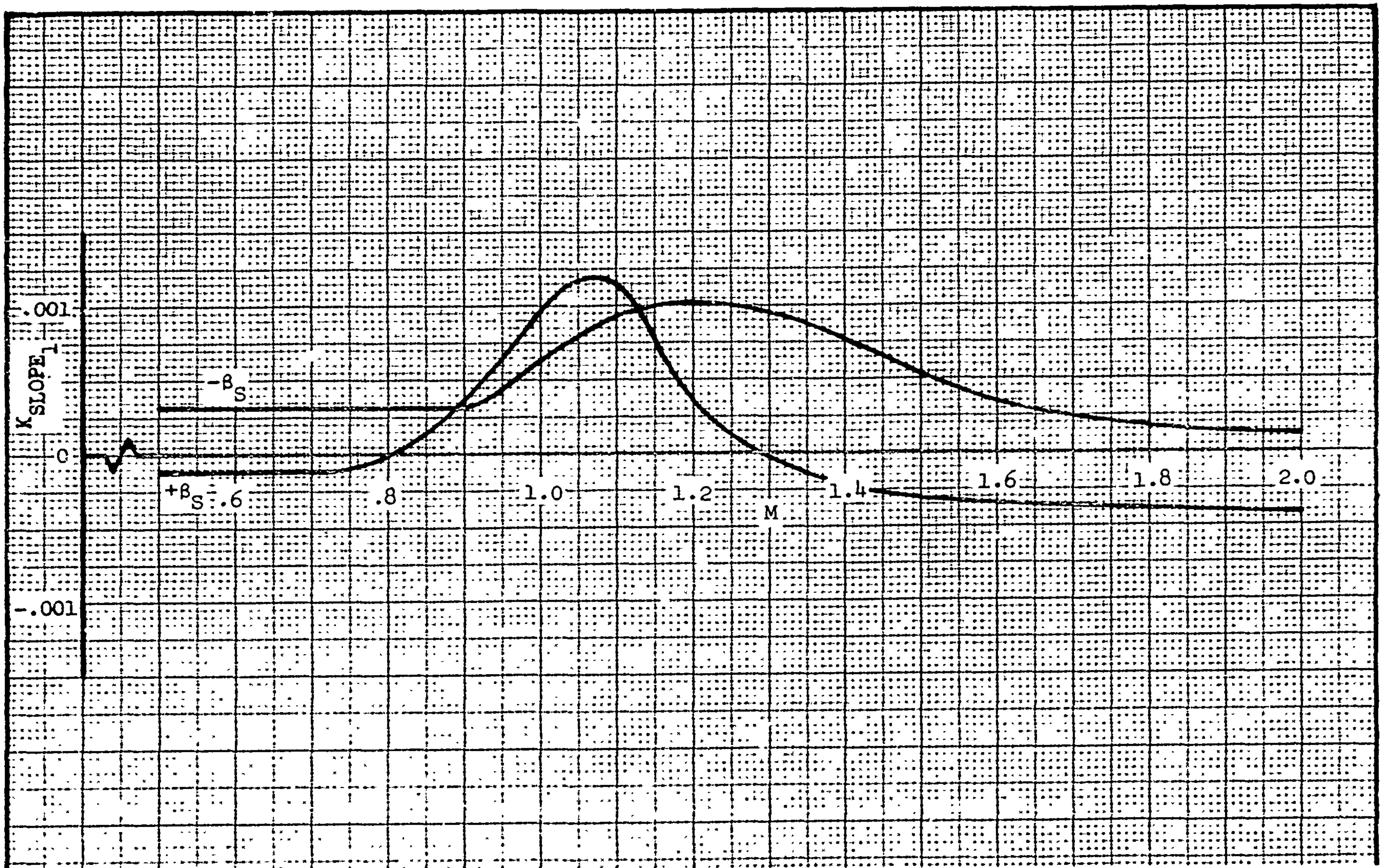

Figure 309. Incremental Axial Force Slope Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

3.5.2.2 Intercept Prediction

The equation to predict incremental axial force intercept per degree β_S, $\Delta\left(\frac{\Delta F}{q}\right)_{\alpha=0_{\beta_S}}$, is given below.

$$\Delta\left(\frac{\Delta F}{q}\right)_{\alpha=0_{\beta_S}} = K_{SLOPE_1} \cdot S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental $C_{A_{\alpha=0}}$ per degree β_S with S_{REF}, $\frac{1}{deg.}$, Figure 310.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

A numerical example illustrating the use of the preceding equation is found in Subsection 3.5.[illegible].

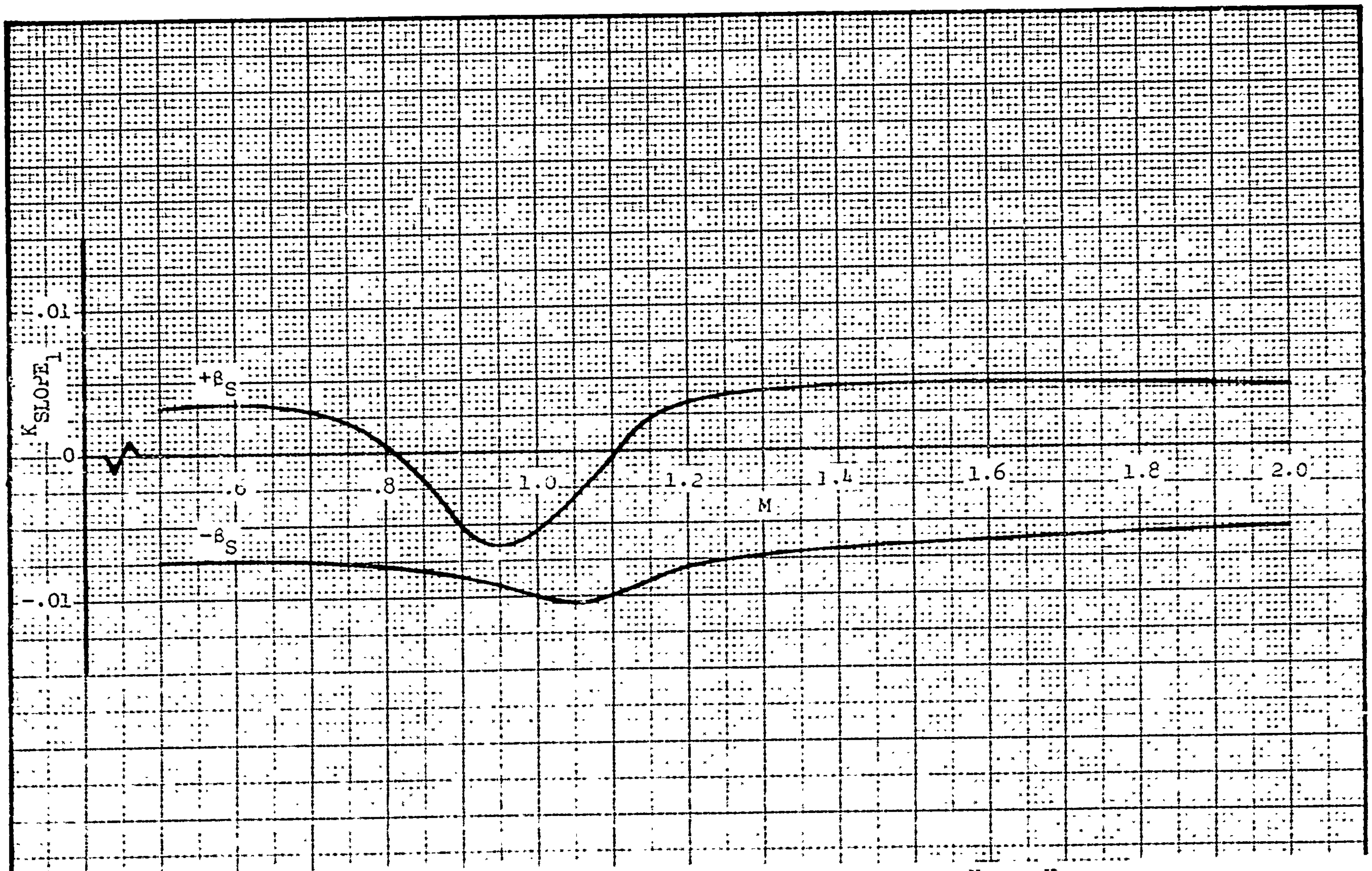

Figure 310. Incremental Axial Force Intercept Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

3.5.3 Increment - Adjacent Store Interference

The discussion of incremental axial force intercept is similar to that of side force found in Subsection 3.1.3.

3.5.3.1 Slope Prediction

The incremental effect due to adjacent store interference on axial force slope is negligible; therefore, no prediction is included in this subsection.

3.5.3.2 Intercept Prediction

The equation to predict incremental axial force intercept, $\Delta\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\ INTF}}$, is given below.

$$\Delta\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\ INTF}} = [(K_{SLOPE_1} + \Delta K_{SLOPE_\eta}) \frac{S_{REF}\, y_{INTF}\, d_{INTF}\, L_{INTF}}{L \cdot d} + K_{INTC_1} + \Delta K_{INTC_\eta} + \Delta K_{INTC_{INTF}}] S_{REF}$$

where:

K_{SLOPE_1} - Variation of incremental $C_{A_{\alpha=0}}$ with $\frac{S_{REF}\, y_{INTF}\, d_{INTF}\, L_{INTF}}{L \cdot d}$, $\frac{1}{in. - ft^2.}$, Figure 311.

ΔK_{SLOPE_η} - Incremental change in K_{SLOPE_1} due to spanwise position, $\frac{1}{in. - ft.}$, Figure 312.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

y_{INTF} - Store separation distance, in., defined in Subsection 3.1.3

d_{INTF} - Effective diameter of the interfering store, ft., defined in Subsection 3.1.3.

L_{INTF} - Length of interfering store installation, in., for single stores equal to the physical length and for multiple stores equal to the distance from the nose of the forward store to the tail of the aft store.

d - Subject store diameter, ft.

L - Subject store length, in.

K_{INTC_1} - Value of $\Delta C_{A_{\alpha=0}}$ when $\frac{S_{REF} y_{INTF} d_{INTF} L_{INTF}}{L \cdot d} = 0$, Figure 313.

ΔK_{INTC_η} - Incremental change in K_{INTC_1} due to spanwise store position, Figure 314.

$\Delta K_{INTC_{INTF}}$ - Incremental change in K_{INTC_1} due to store body - fin interference, presented as a function of $\frac{\text{FIN PPA}}{\text{BODY PPA}}$, Figure 315.

Example: Calculate $\Delta\left(\frac{AF}{q}\right)_{\alpha=0_{INTF}}$ for a 300-gallon tank on A-7 center pylon with an M117 on the inboard pylon at M=0.5.

Required for Computation:

$S_{REF} = 3.83$ ft^2.

$d = 2.2$ ft.

$L = 226$ in.

$d_{INTF} = 1.33$ ft.

$L_{INTF} = 87.$ in.

$y_{INTF} = 14.7$ in.

$\eta = .418$

PLAN PROJECTED FIN AREA = 448 in^2.

PLAN PROJECTED BODY AREA = 4560 in^2.

$K_{SLOPE_1} = -.0011$, Figure 311

$\Delta K_{SLOPE_\eta} = .0014$, Figure 312

$K_{INTC_1} = .021$ Figure 313

$\Delta K_{INTC_\eta} = -.007$, Figure 314

$\Delta K_{INTC_{INTF}} = 0.0$ Figure 315

substituting,

$$\Delta\left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ INTF}} = [(-.0011 + .0014)\frac{3.83(14.7)(1.33)(87)}{2.2(226)} + .021 - .007 + .0]3.83 = .069\ ft^2.$$

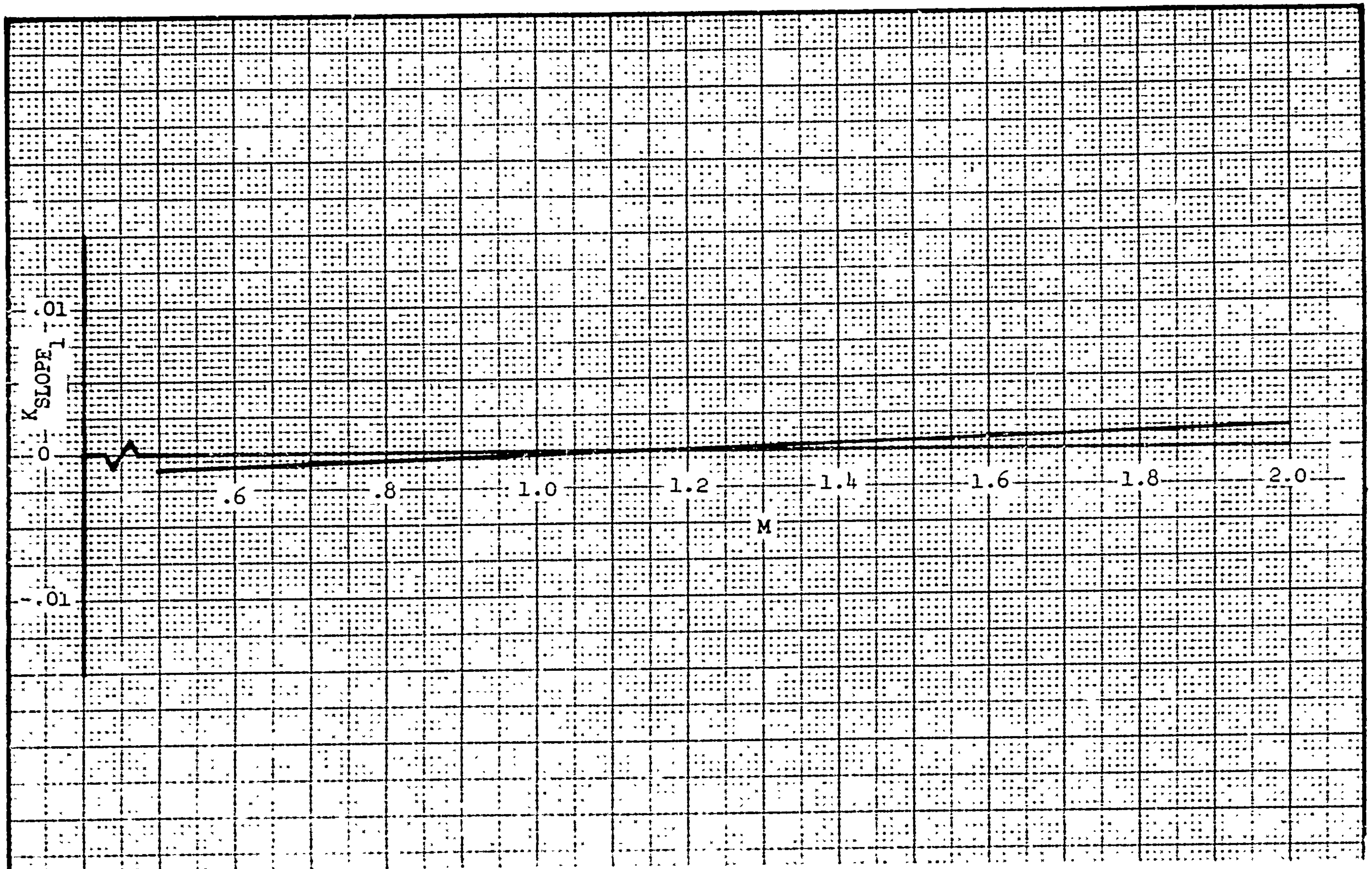

Figure 311. Incremental Axial Force Intercept Due to Interference - K_{SLOPE_1} for Inboard and Outboard Adjacent Store Interference

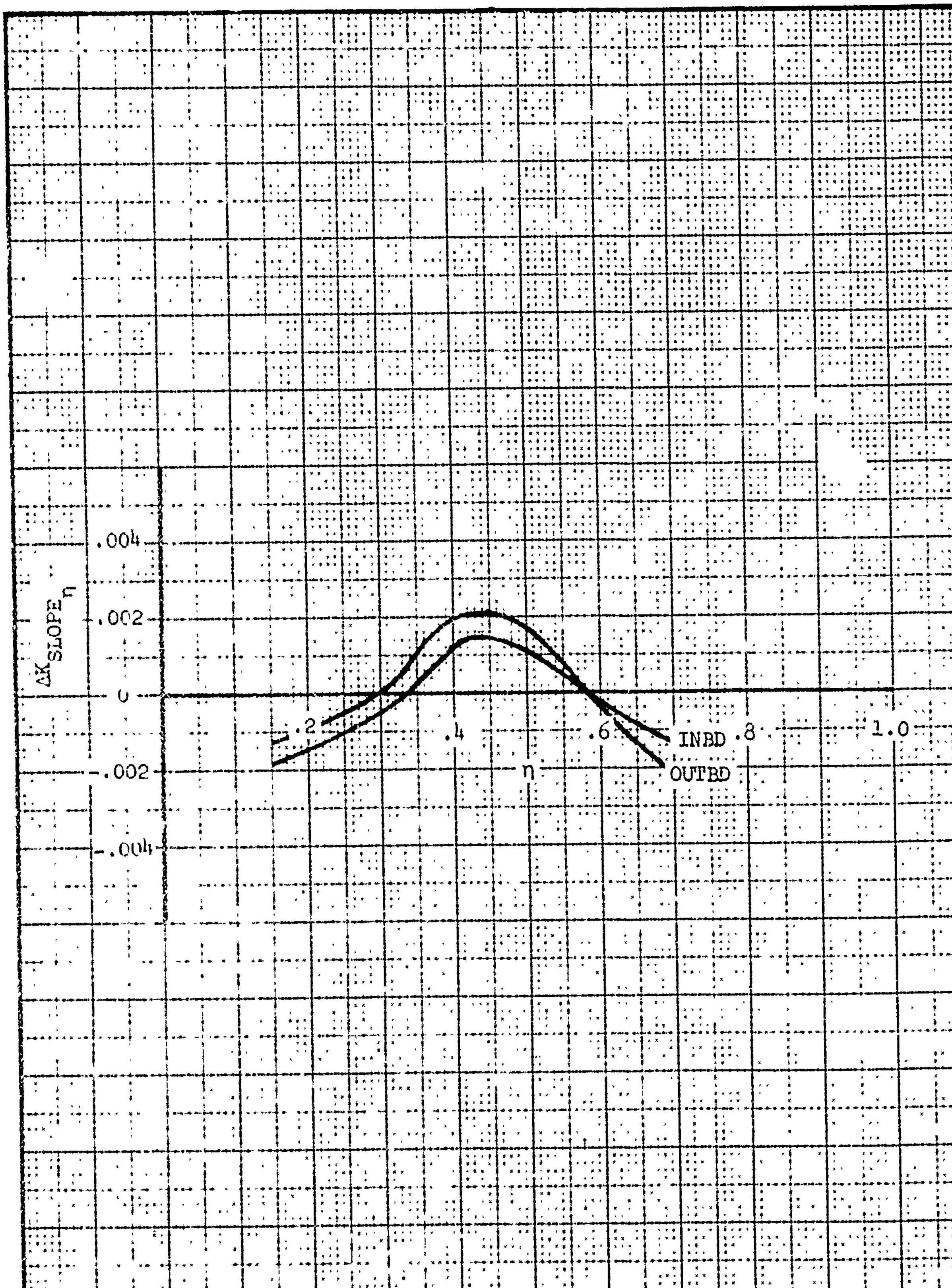

Figure 312. Incremental Axial Force Intercept Due to Interference - K_{SLOPE_1} Spanwise Correction for Inboard and Outboard Interference

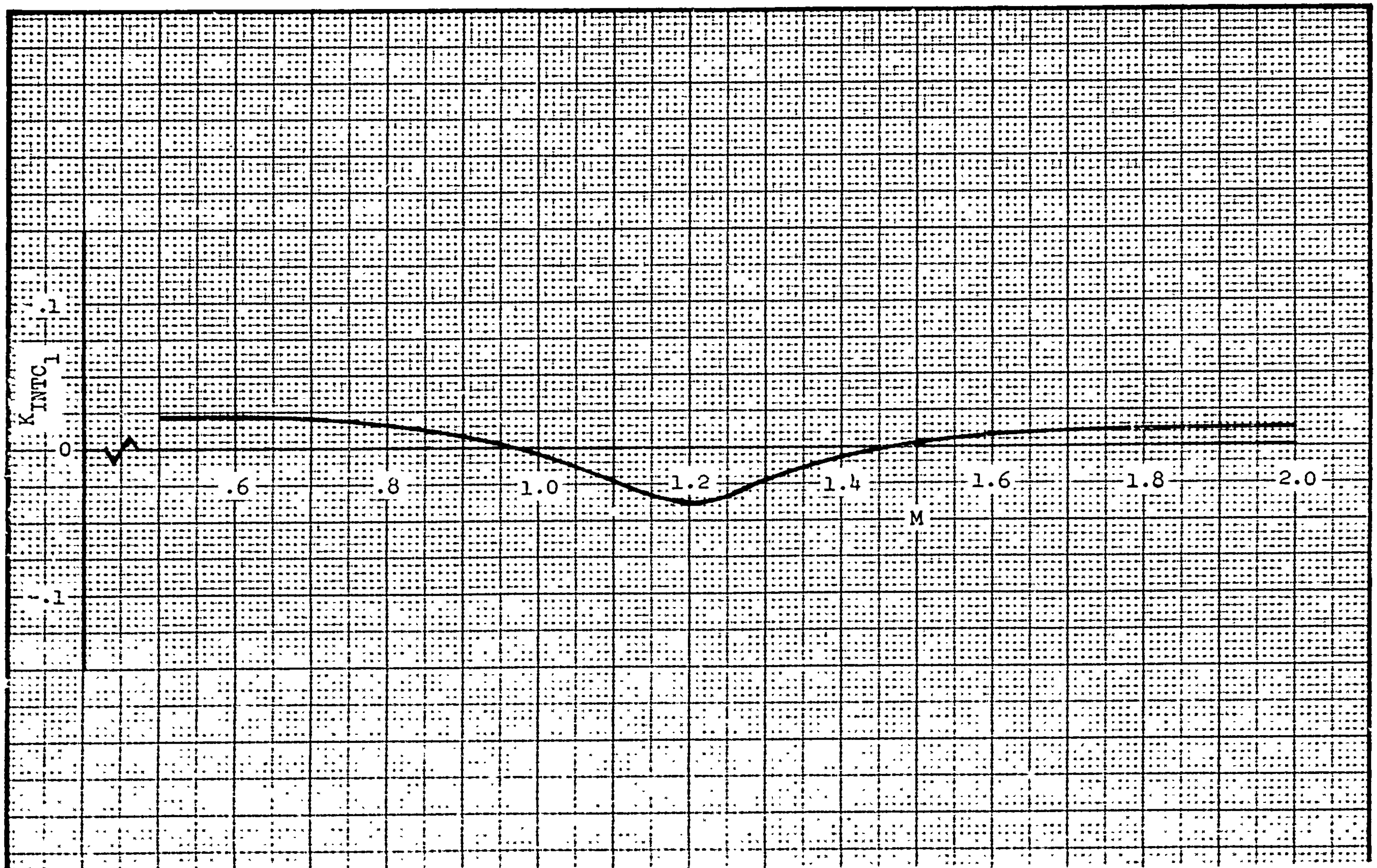

Figure 313. Incremental Axial Force Intercept Due to Interference - K_{INTC_1} for Inboard and Outboard Adjacent Store Interference

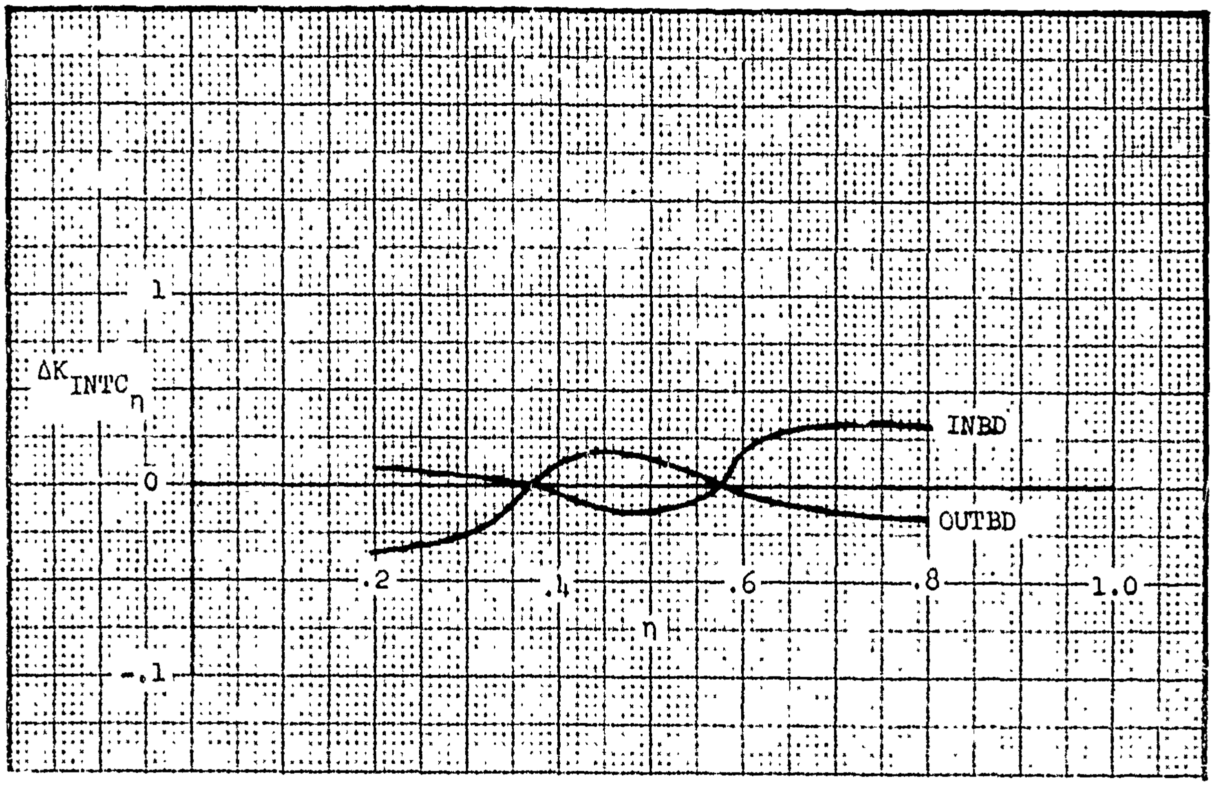

Figure 511. Incremental Axial Force Intercept Due to Interference - K_{INTC} Spanwise Correction for Inboard and Outboard Interference $_{1}$

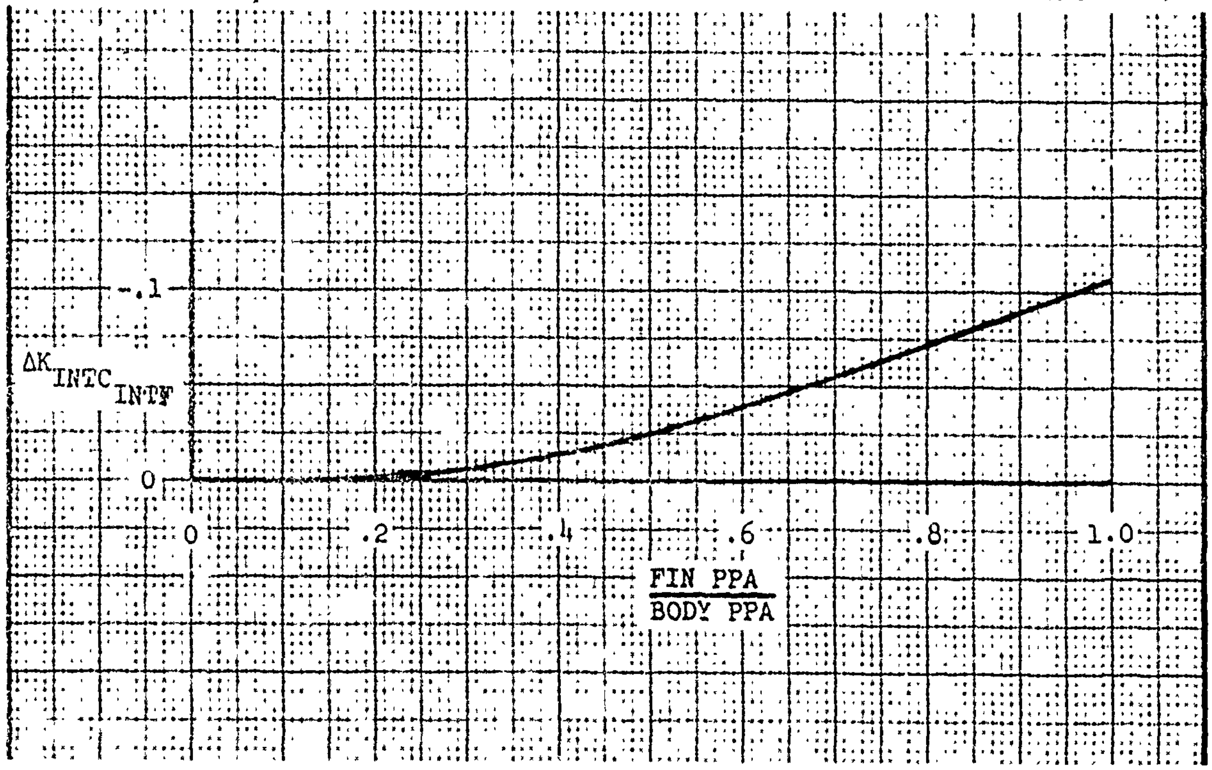

Figure 512. Incremental Axial Force Intercept Due to Interference - Correction for Inboard and Outboard Interference

3.6 ROLLING MOMENT

3.6.1 Basic Airload

Captive store rolling moment has been found to be primarily a function of store fin area and location with respect to the store roll axis. Stores with large fins experience large installed rolling moments while those stores without fins experience very small (approximately zero) captive rolling moments. The effect of store fin location with respect to the store roll axis has been classified into two categories - symmetric and unsymmetric. Examples of these classifications are illustrated in Figure 316.

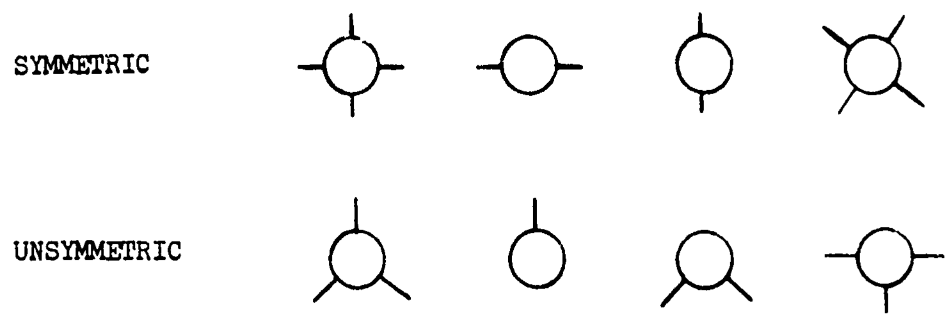

Figure 316. Symmetric and Unsymmetric Store Fin Configurations

3.6.1.1 Slope Prediction

The variation of rolling moment with angle of attack is given by the equation below.

$$\left(\frac{RM}{q}\right)_\alpha = (K_{SLOPE_1} + \Delta K_{SLOPE_{INTF}})(\text{FIN AREA})K_{\Lambda_1}$$

where:

K_{SLOPE_1} - Variation of rolling moment slope with fin area, $\frac{ft.}{deg.}$. Curves are shown for stores with symmetric and unsymmetric fins, Figure 317.

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to the interference effect of the fuselage for high wing aircraft, $\frac{ft.}{deg.}$, Figure 318.

FIN AREA - Total planform area of all store fins, ft^2.

K_{Λ_1} - Aircraft wing sweep correction factor, $\frac{\sin \Lambda}{\sin 45^\circ}$, where Λ is the aircraft wing quarter-chord sweep angle in degrees.

Example:

Calculate $\left(\frac{RM}{q}\right)_\alpha$ for 300-gallon tank on A-7 center pylon at M = 0.5.

Required for Computation:

FIN AREA = 6.07 ft^2.

$\eta' = .270$

$K_{\Lambda_1} = \frac{\sin 35^\circ}{\sin 45^\circ} = .811$

$K_{SLOPE_1} = -.013$ - Figure 317 (symmetric)

$\Delta K_{SLOPE_{INTF}} = 0.0$ - Figure 318

$$\left(\frac{RM}{q}\right)_\alpha = (-.013 + 0.0)(6.07)(.811) = -.064 \ \frac{ft^3.}{deg.}$$

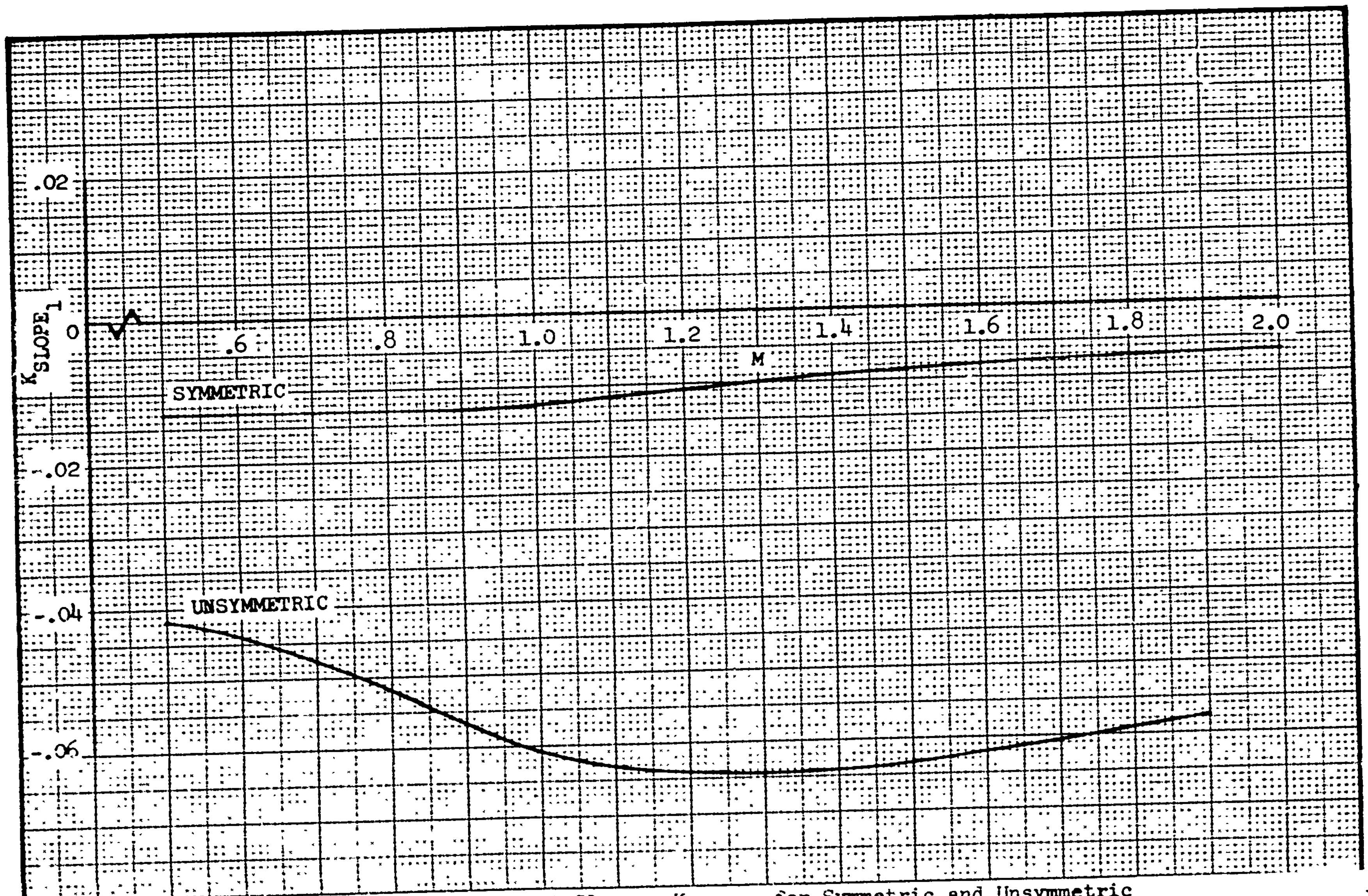

Figure 317. Rolling Moment Slope - K_{SLOPE_1} for Symmetric and Unsymmetric Stores

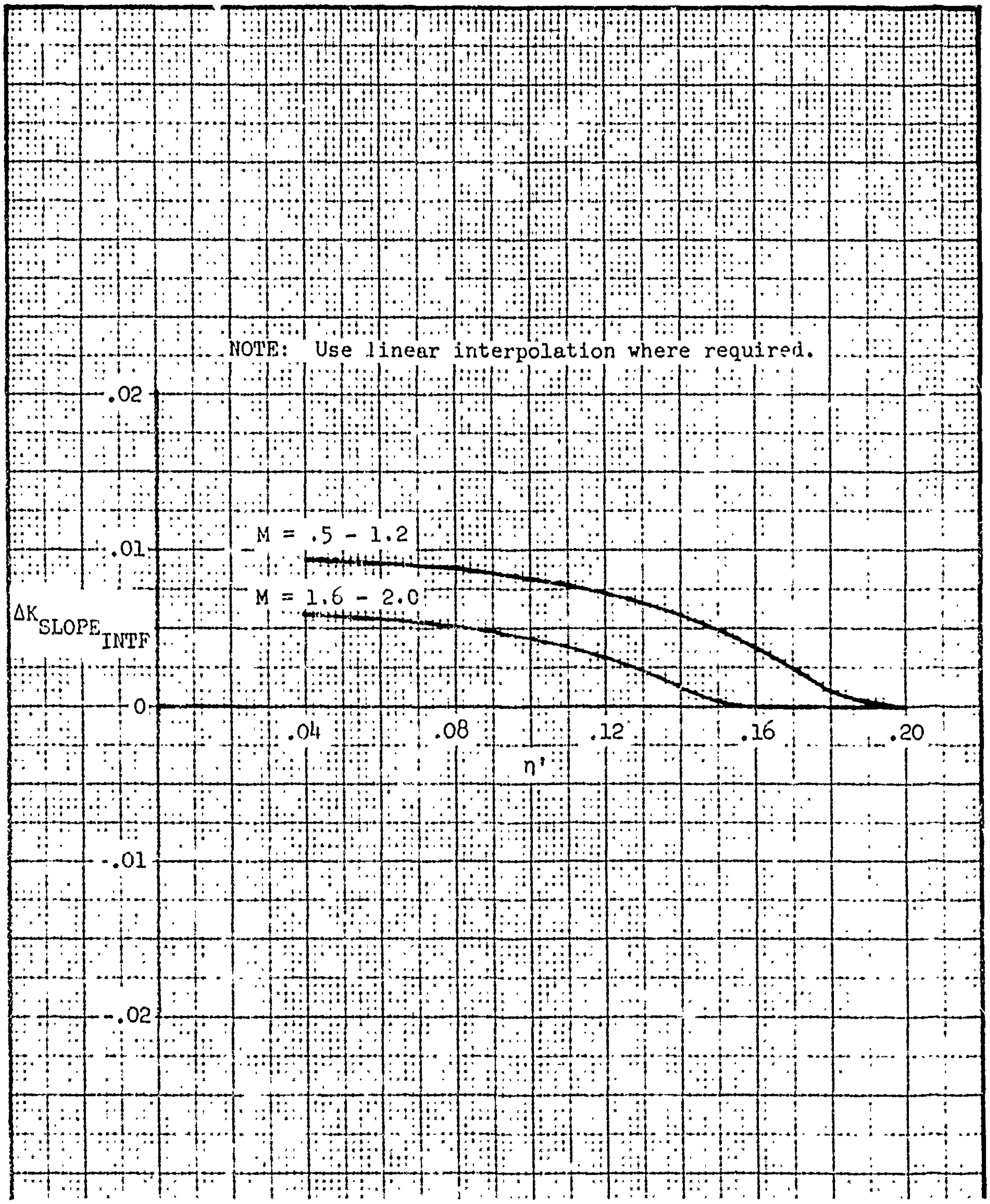

Figure 53. Rolling Moment Slope - K_{SLOPE_1} Fuselage Interference Correction

3.6.1.2 Intercept Prediction

The equation below gives the value of rolling moment at zero angle of attack.

$$\left(\frac{RM}{q}\right)_{\alpha=0} = K_{SLOPE_1}(\text{FIN AREA})K_{\eta}$$

where:

K_{SLOPE_1} - Variation of rolling moment intercept with fin area, ft., Figures 319 to 322.

FIN AREA - Total planform area of all store fins, ft^2.

K_{η} - Store spanwise location correction factor, Figure 323.

Example:

Calculate $\left(\frac{RM}{q}\right)_{\alpha=0}$ for 300-gallon tank on A-7 center pylon at M = 0.5.

Required for Computation:

FIN AREA = 6.07 ft^2.

η = .418

C_{LOCAL} = 127 in.

K_{SLOPE_1} = .05 - Figure 319

K_{η} = .99 - Figure 323

$$\left(\frac{RM}{q}\right)_{\alpha=0} = (.05)(6.07)(.99) = .300 \text{ ft}^3.$$

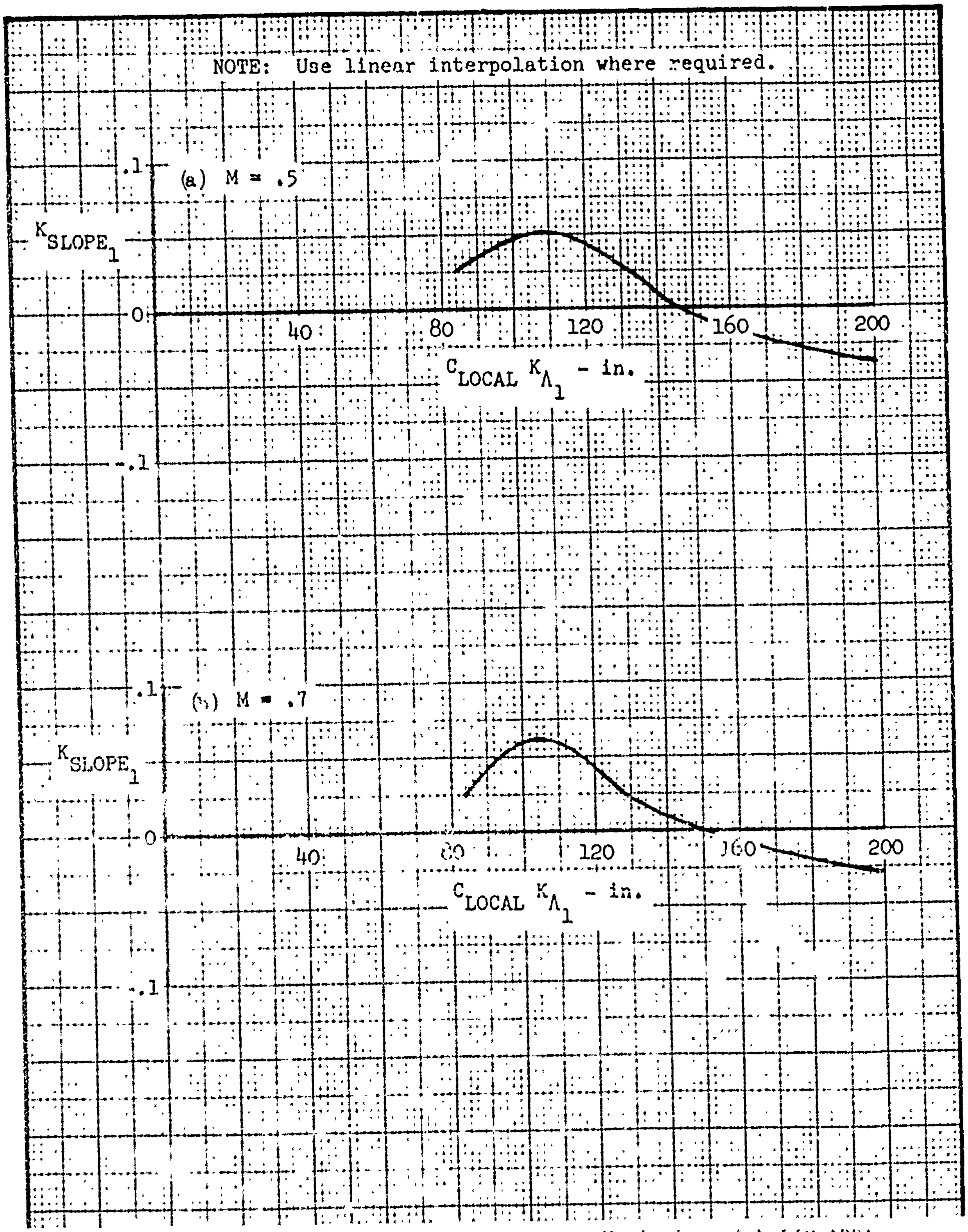

Figure 319. Rolling Moment Intercept - Variation with FIN AREA
M=0.5 and M=0.7

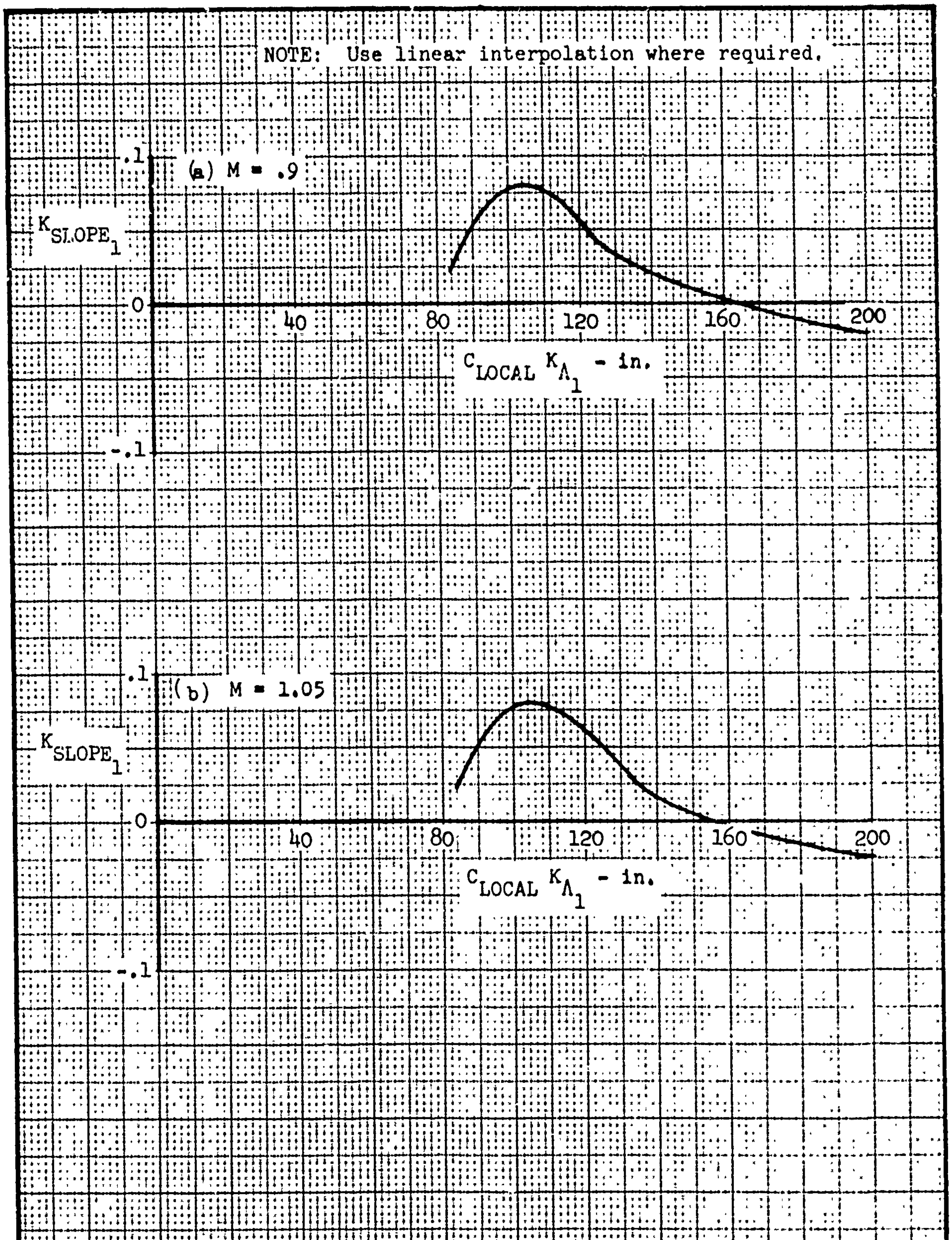

Figure 320. Rolling Moment intercept - Variation with FIN AREA M=0.9 and M=1.05

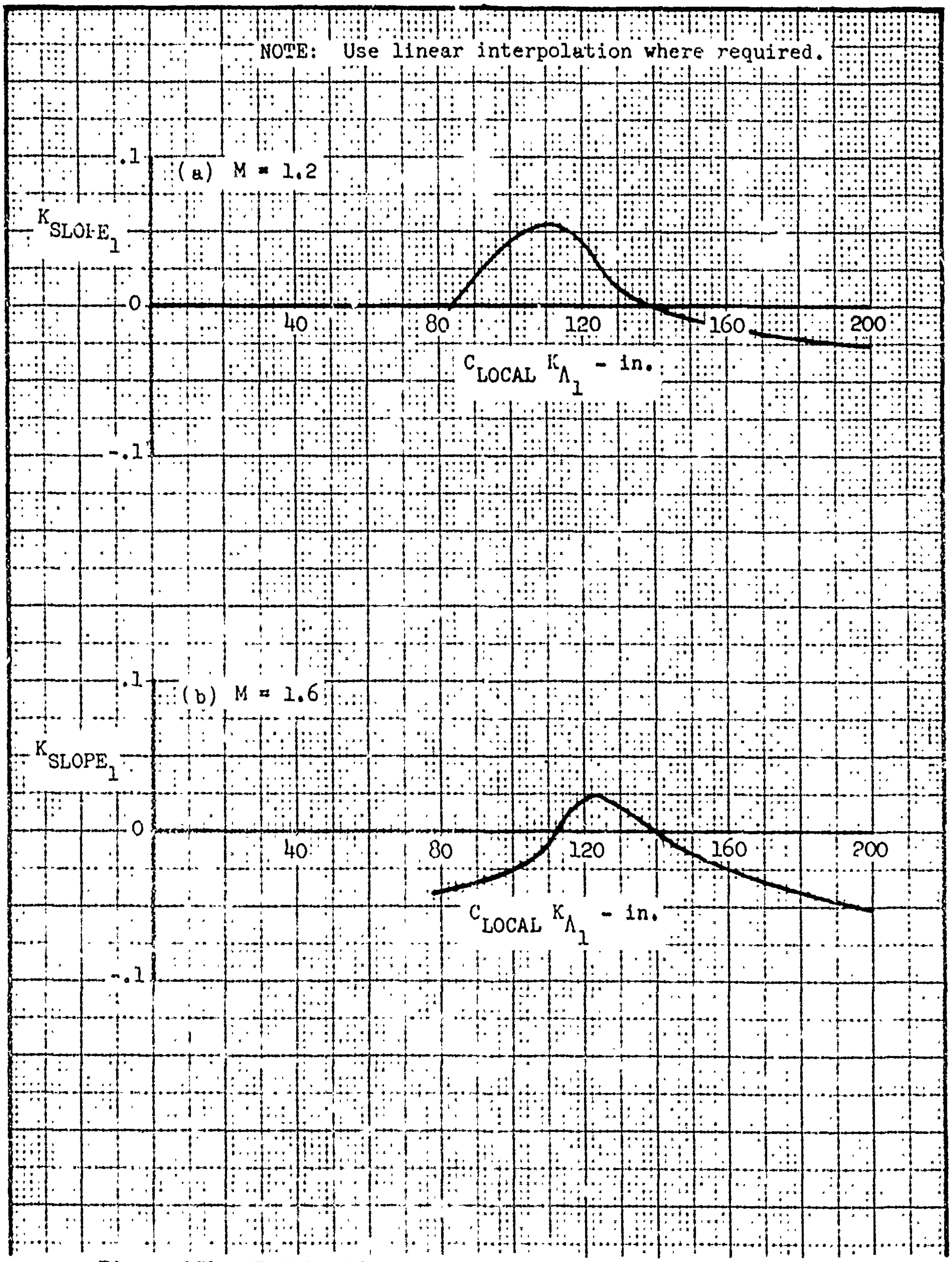

Figure 321. Rolling Moment Intercept - Variation with FIN AREA
M=1.2 and M=1.6

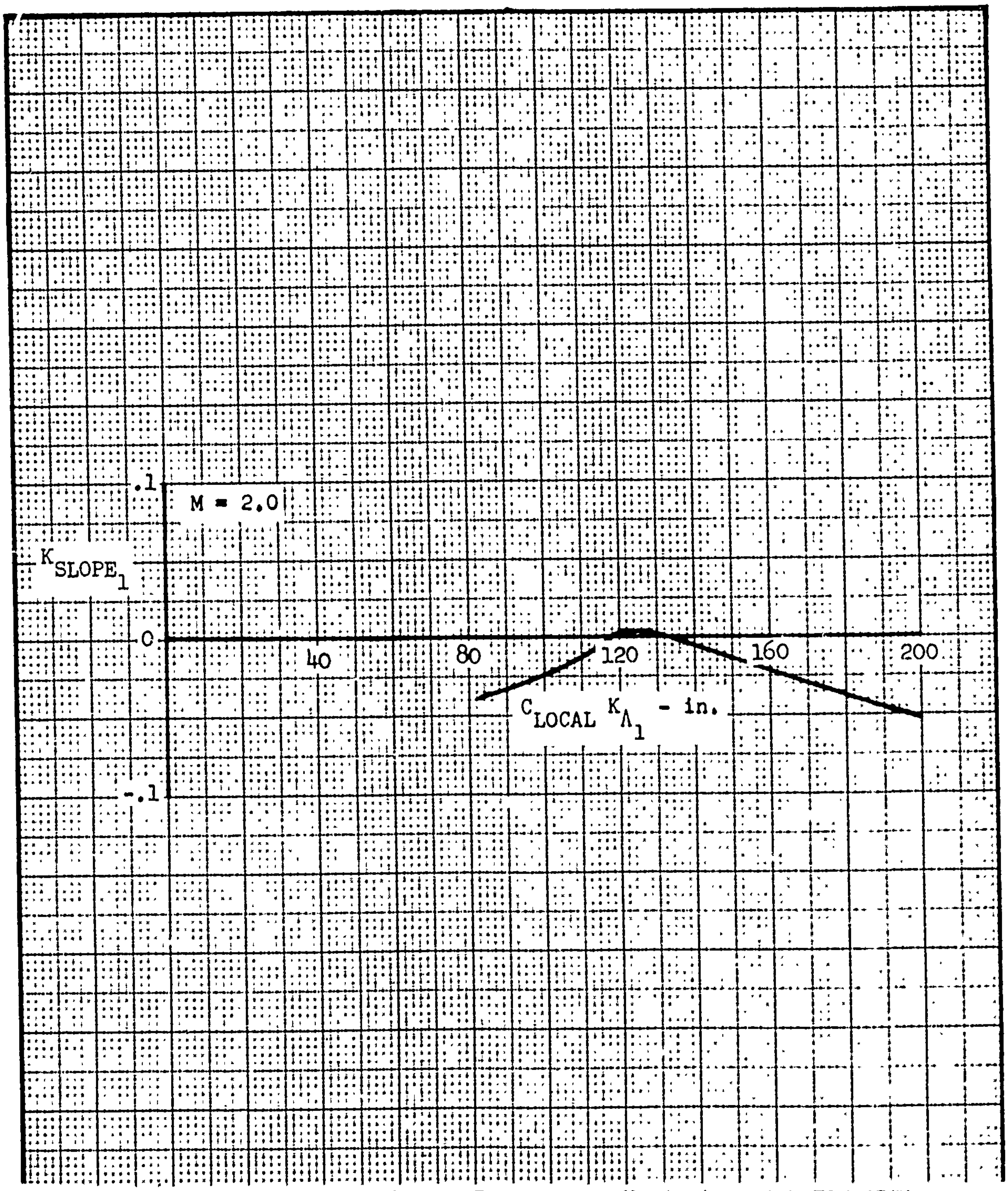

Figure 322. Rolling Moment Intercept - Variation with FIN AREA
M=2.0

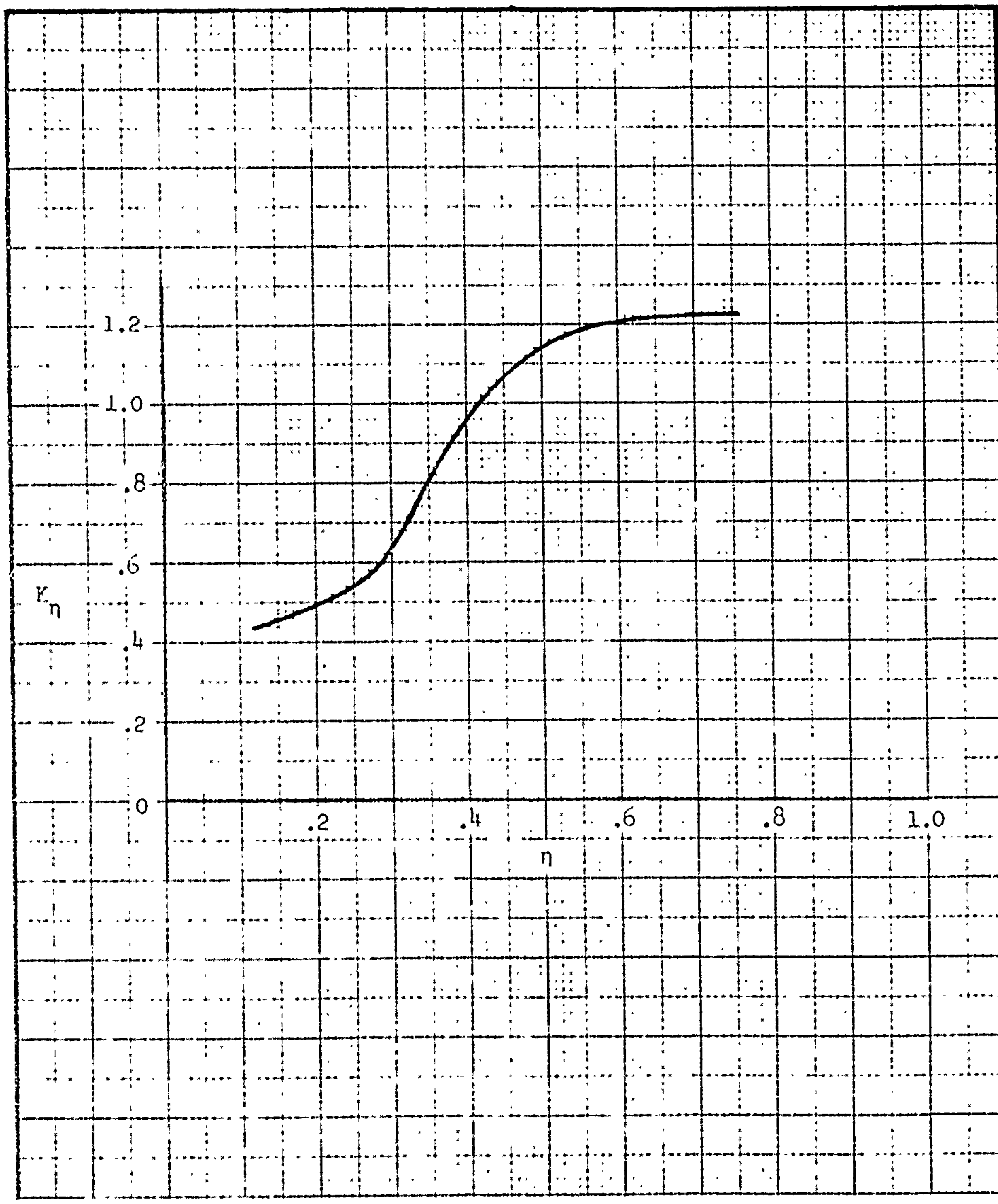

Figure 523. Rolling Moment Intercept - Spanwise Correction

3.6.2 Increment - Aircraft Yaw

The discussion of incremental rolling moment intercept is similar to that of side force found in Subsection 3.1.2

3.6.2.1 Slope Prediction

The incremental effect due to adjacent store interference on rolling moment slope is negligible; therefore, no prediction is included in this section.

3.6.2.2 Intercept Prediction

The equation for predicting the incremental rolling moment intercept per degree β_S, $\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{\beta_S}}$, is given below.

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{\beta_S}} = K_{INTF} K_{SLOPE_1} (\text{FIN AREA}) K_{\Lambda_1}$$

where:

K_{INTF} - Correction factor due to interference effect of the fuselage for high wing aircraft, Figure 325.

K_{SLOPE_1} - Variation of incremental rolling moment intercept per degree β_S with FIN AREA, $\frac{ft}{deg}$, Figure 324.

FIN AREA - Total store fin area, ft^2

K_{Λ_1} - $\frac{\sin \Lambda}{\sin 45^\circ}$, Aircraft wing sweep correction factor where Λ is the quarter-chord sweep angle for the subject wing.

Example: Calculate $\Delta\left(\frac{RM}{q}\right)_{\alpha=0}$ for a 300-gallon tank on A-7 center pylon at M = 0.7 and $\beta_S = 4^\circ$.

Required for Computation:

$\eta' = .27$

$K_{\Lambda_1} = .811$

FIN AREA = $6.07\ ft^2$.

$K_{SLOPE_1} = -.0172$ - Figure 3[illegible]4, + [illegible] curve

$K_{[illegible]} = 1.0$ - Figure [illegible]

substituting,

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{\beta_S}} = (1.0)(-.0172)(6.07)(.811)$$

$$= -.0846 \ \frac{ft^3.}{deg.}$$

and using the equation of Subsection 3.6.2

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0} = \Delta\left(\frac{RM}{q}\right)_{\alpha=0_{\beta_S}} \cdot \beta_S$$

$$= (-.0846)(4^\circ)$$

$$= -.3384 \ ft^3.$$

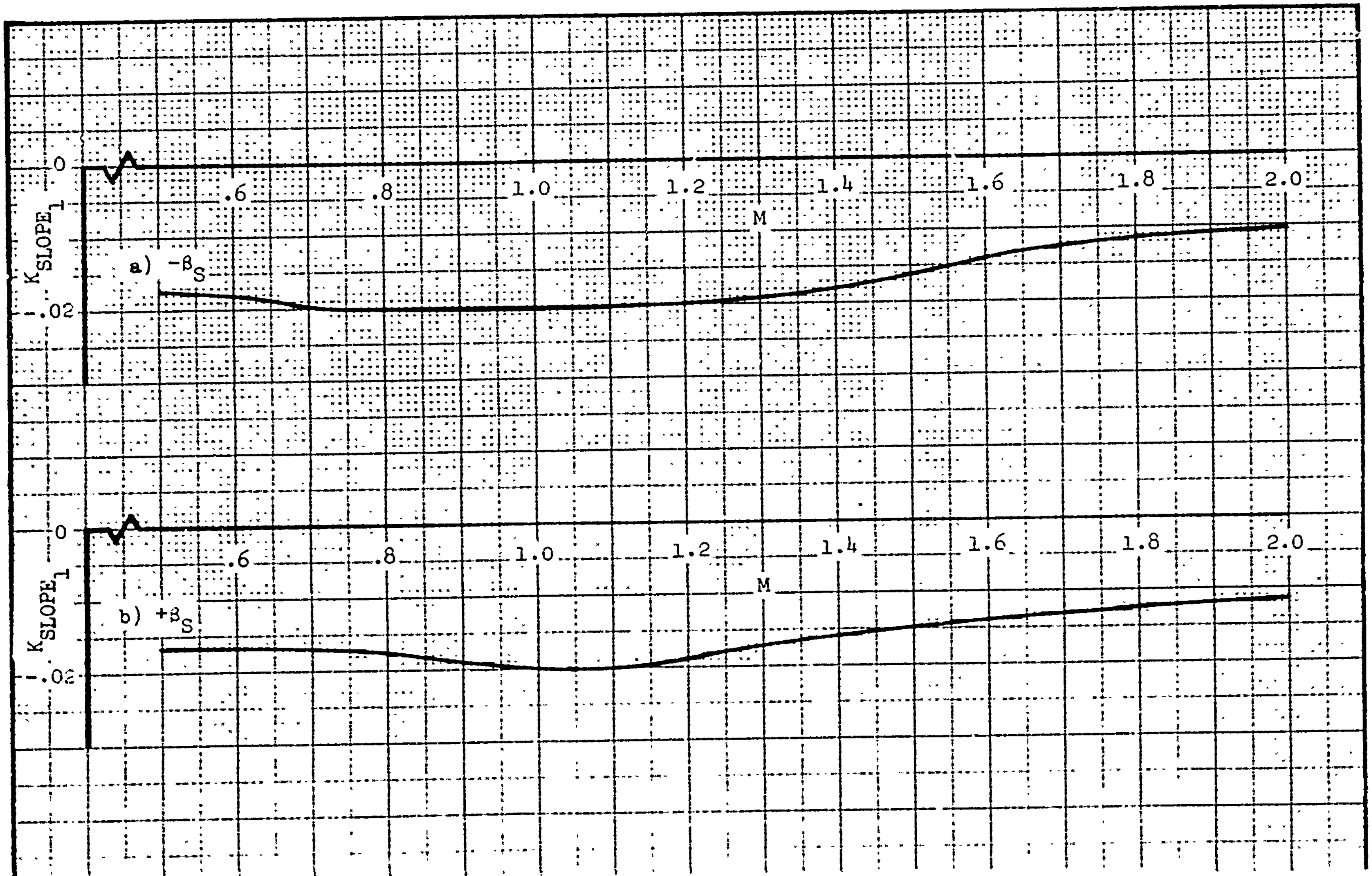

Figure 324. Incremental Rolling Moment Intercept Due to Yaw - K_{SLOPE_1} for Positive and Negative Store Yaw

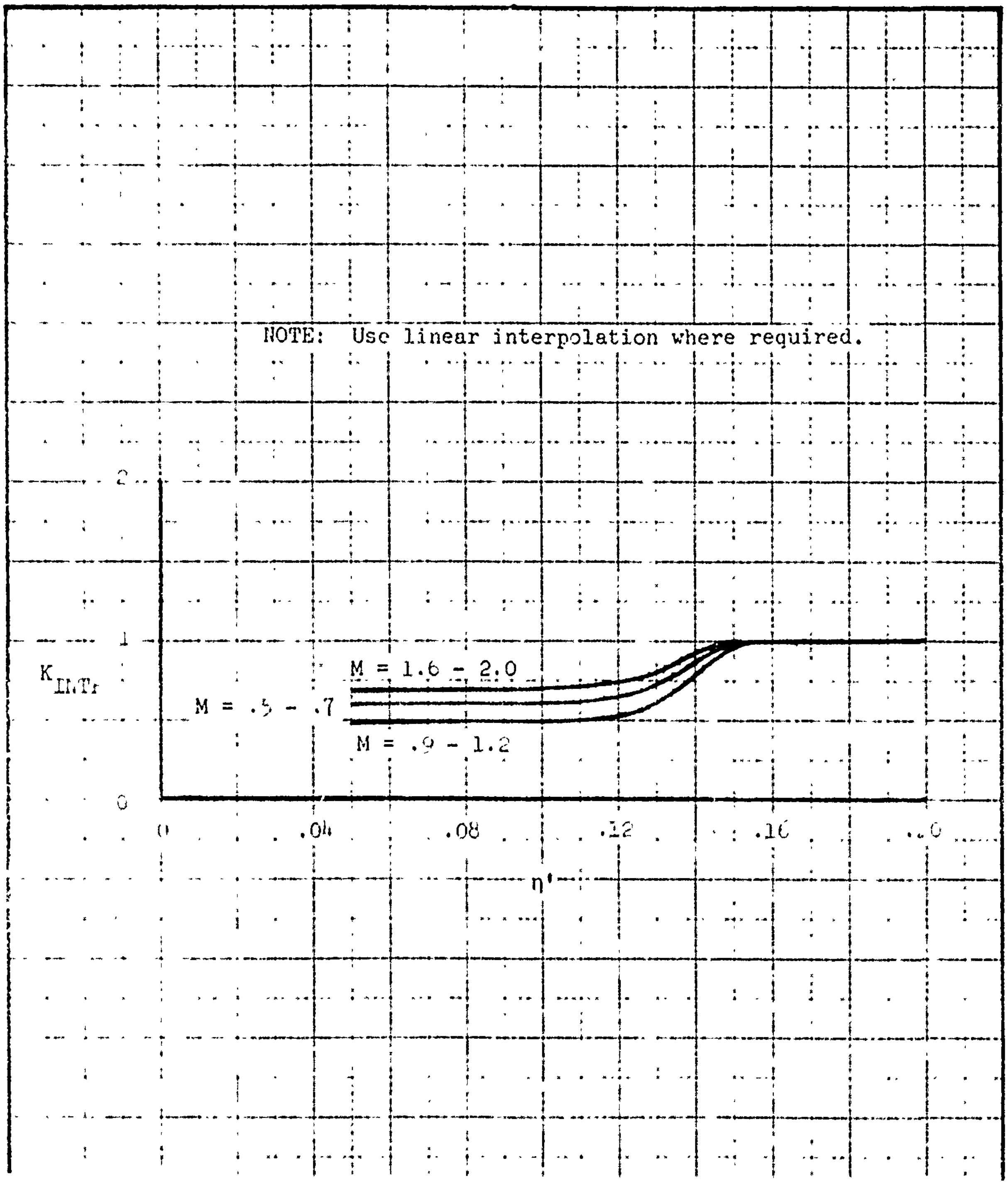

Figure 325. Incremental Rolling Moment Intercept Due to Yaw - K_{SLOPE_1} Fuselage Interference Correction

3.6.3 Increment - Adjacent Store Interference

The discussion of incremental rolling moment intercept is similar to that of side force found in Subsection 3.1.3.

3.6.3.1 <u>Slope Prediction</u>

The incremental effect due to adjacent store interference on rolling moment slope is negligible; therefore, no prediction is included in this section.

3.6.3.2 <u>Intercept Prediction</u>

The equation used to predict incremental rolling moment intercept is presented below.

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ INTF}} = \left(K_{SLOPE_1} + \Delta K_{SLOPE_d} + \Delta K_{SLOPE_\eta} + \Delta K_{SLOPE_{C_{LOCAL}}}\right) \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of incremental rolling moment intercept with FIN AREA, ft., Figure 326.

ΔK_{SLOPE_d} - Incremental change in K_{SLOPE_1} due to changes in diameter of subject store, ft., Figure 327.

ΔK_{SLOPE_η} - Incremental change in K_{SLOPE_1} due to store spanwise position, ft., Figure 328.

$\Delta K_{SLOPE_{C_{LOCAL}}}$ - Incremental change in K_{SLOPE_1} with local chord length, ft., Figure 329.

FIN AREA - Total store fin area, ft^2.

Example: Calculate $\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{INTF}}$ for 300-gallon tank on A-7 center pylon with an M117 on the inboard pylon and $M = 0.5$

Required for Computation:

$d = 2.2$ ft.

FIN AREA $= 6.07\ ft^2$.

$\eta = .418$

$C_{LOCAL} = 127.6$ in.

$K_{\Lambda_1} = .811$

$K_{SLOPE_1} = .015$ Figure 326

$\Delta K_{SLOPE_d} = 0.0$ Figure 327

$\Delta K_{SLOPE_\eta} = .006$ Figure 328

$\Delta K_{SLOPE_{C_{LOCAL}}} = 0.0$ Figure 329

substituting,

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ INTF}} = (.015 + 0.0 + .006 + 0.0)\ 6.07$$
$$= .127\ ft^3.$$

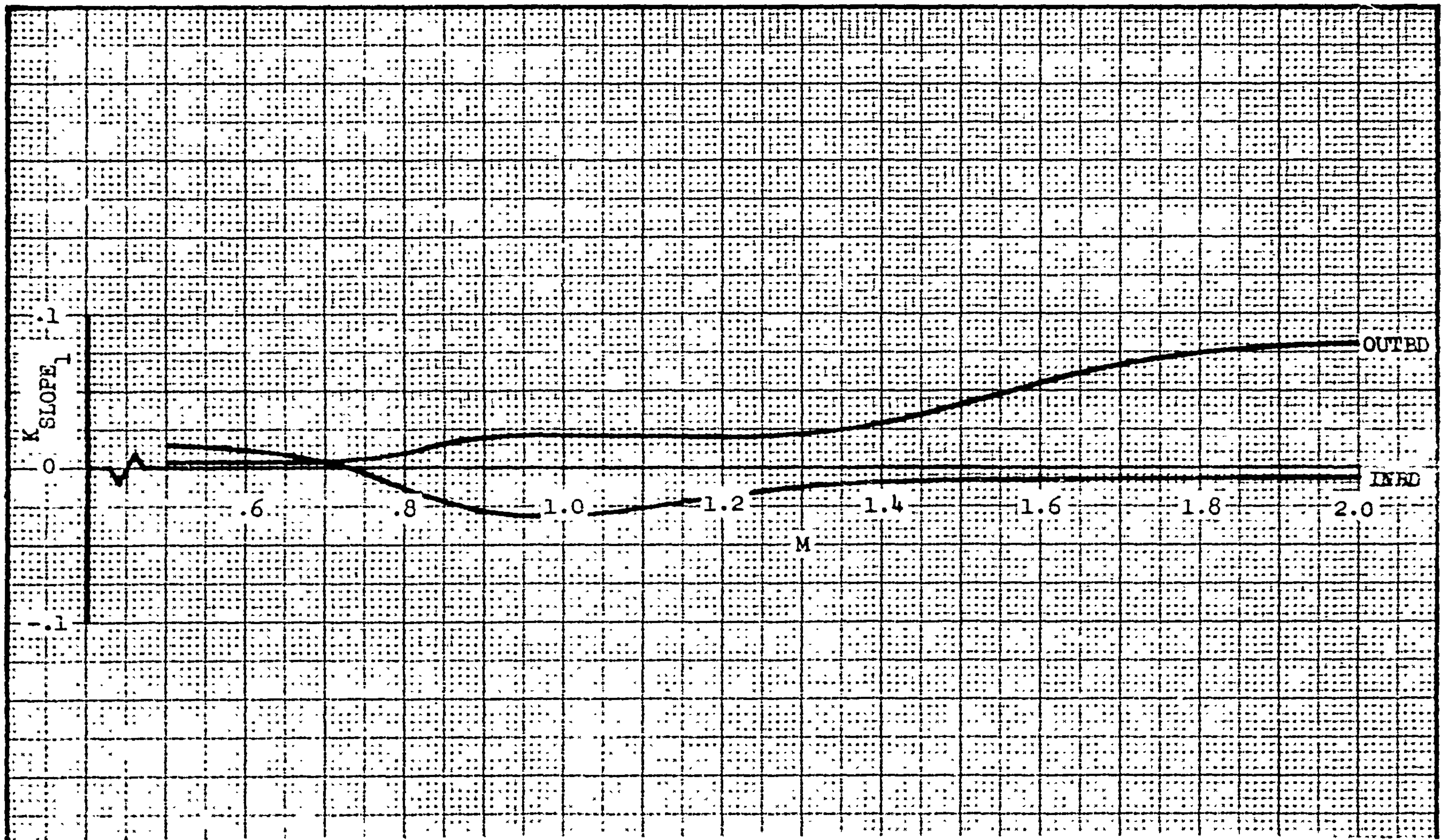

Figure 326. Incremental Rolling Moment Intercept Due to Interference - K_{SLOPE_1} for Inboard and Outboard Adjacent Store Interference

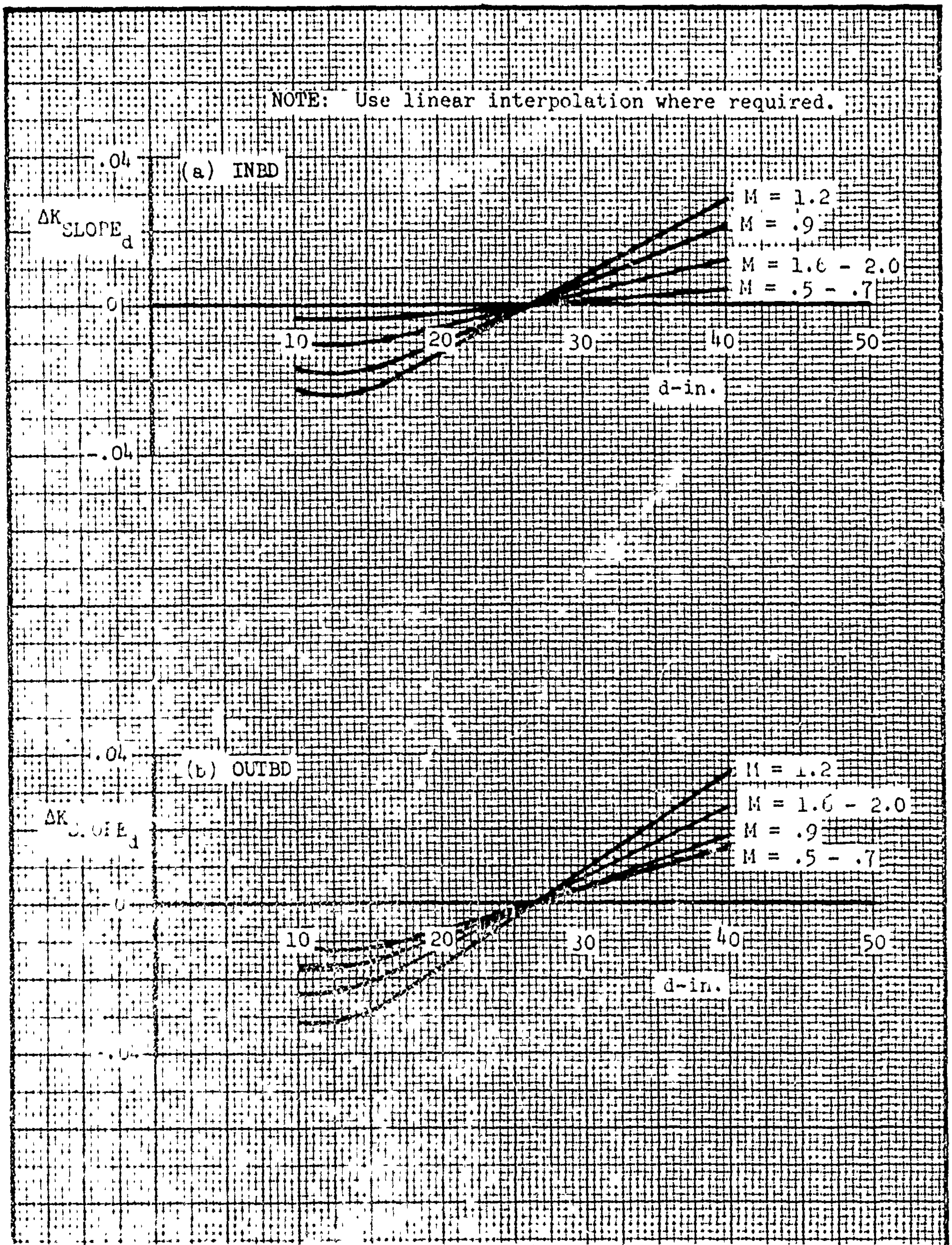

Figure 5. Incremental Rolling Moment Intercept Due to Interference - K_{SLOPE_1} Store Diameter Correction

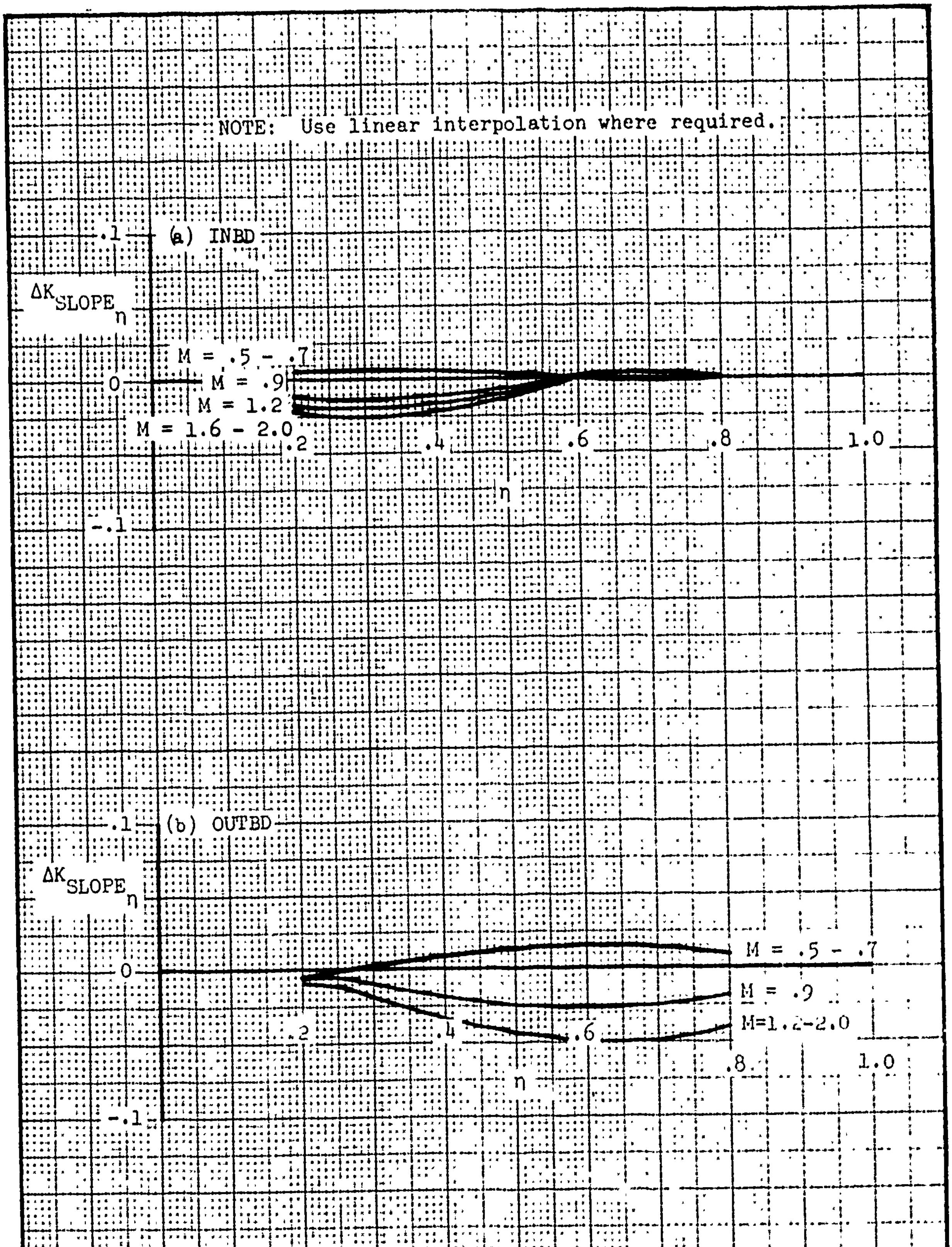

Figure 328. Incremental Rolling Moment Intercept Due to Interference - K_{SLOPE_1} Spanwise Correction

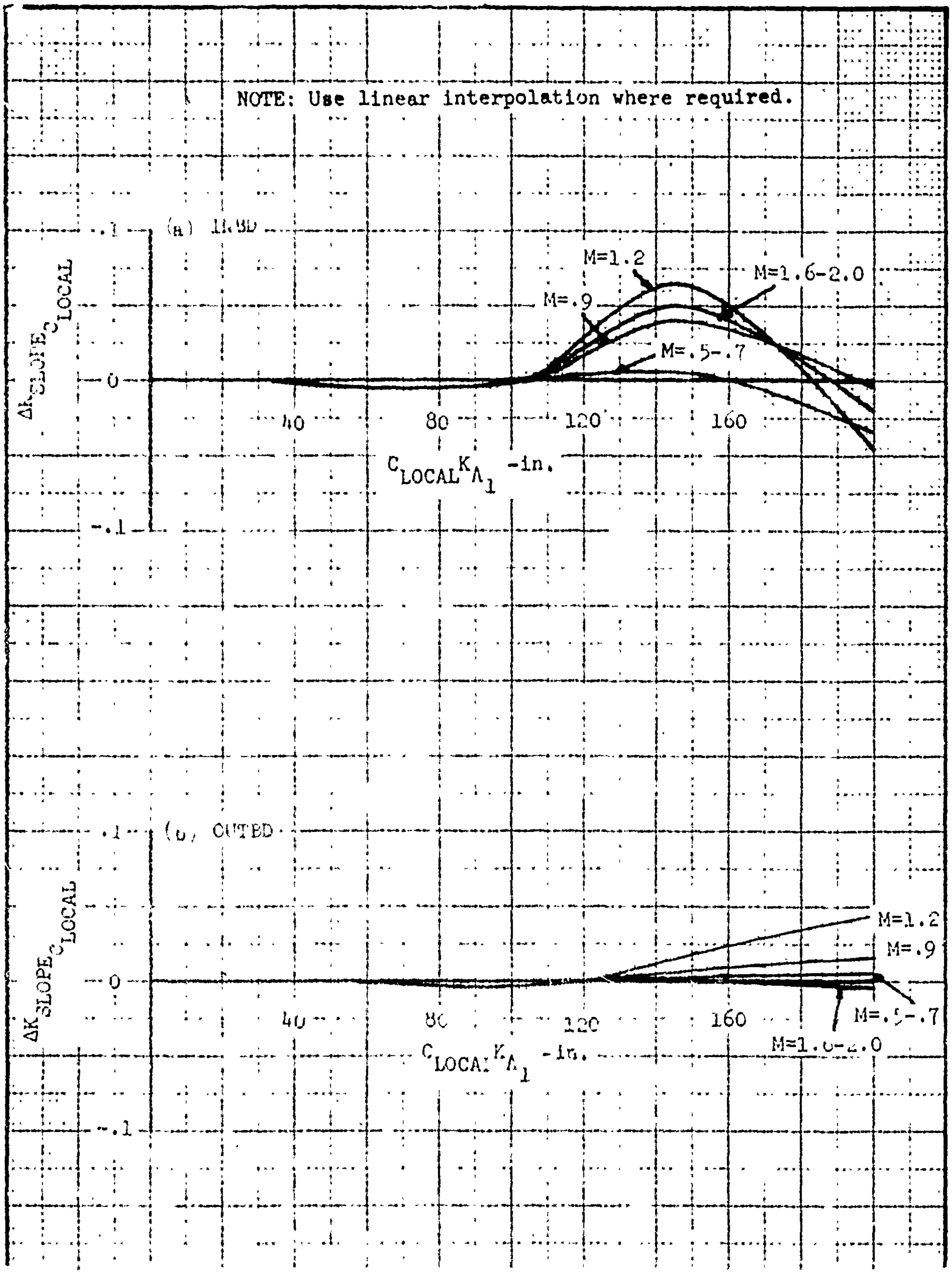

Figure [illegible]. Incremental Rolling Moment Intercept Due to Interference - K_{SLOPE_1} Interference Correction